NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

A STUDY OF ENLISTED TRAINING
AND EDUCATION IN APPLIED OCEANOGRAPHY

by

Karl Leonard Schriner

Thesis Advisor: D. F. Leipper

September 1972

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

A STUDY OF ENLISTED TRAINING
AND EDUCATION IN APPLIED OCEANOGRAPHY

by

Karl Leonard Schriner

Thesis Advisor: D. F. Leipper

September 1972

Approved for public release; distribution unlimited.

A Study of Enlisted Training and Education in Applied Oceanography

by

Karl Leonard Schriner
Commander, United States Naval Reserve
B.S., Eastern Illinois University, 1957

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN OCEANOGRAPHY

from the

NAVAL POSTGRADUATE SCHOOL
September 1972

NAVAL POSTGRADUATE SCHOOL
Monterey, California

Department of Oceanography 2 October 1972

This thesis is one of a series of studies prepared at the Naval Postgraduate School concerning education and training in oceanography. The series includes:

1. "Oceanographic Education of the Naval Officer," by Rear Admiral Robert W. McNitt published in Proceedings of the 6th U. S. Navy Symposium on Military Oceanography, Applied Physics Laboratory, University of Washington, Seattle, Washington, May 1969.

2. "Officer Education and Training in Oceanography for ASW and other Naval Applications," by LCDR Larry W. Waterman, USN, M. S. thesis, March 1972.

3. "Management and the Oceanography Community: A Consideration in Future Navy Oceanography Planning," by LCDR Samuel W. Sigmund, USN, M. S. thesis, September 1972.

4. "A Study of Enlisted Training and Education in Applied Oceanography," by LCDR Karl L. Schriner, USN, M. S. thesis, September 1972.

The first study suggested that billets for oceanography subspecialists be P-coded aboard certain fleet units such as destroyer type ships, submarines, and ASW squadrons and the staffs which support them, and that the billets be established in such a way that postgraduate education was highly desirable but not essential in filling them.

LCDR Waterman's thesis recommended sub-specializations within oceanography and emphasized the relationships between the recommended programs and specific billets throughout the Navy. It featured the ASW application and ocean technology.

LCDR Sigmund's study showed the need for some formalized management education for oceanographers and recommended specifically how it might be arranged.

Finally, LCDR Schriner's analysis concerned all oceanographic education and training for enlisted men. It discussed the working relationship in oceanography between enlisted men and commissioned officers. Based upon the results of a questionnaire it recommends changes in the present program of oceanography training including the establishment of a career pattern for "specialists."

ABSTRACT

This study concludes that the primary reason for present programs of enlisted training and education in oceanography is to support ASW. There is a significant lack of courses, schools, and self-study material available to enlisted personnel on the subject of oceanography. Through more extensive training the aviation ASW community is more advanced than the surface ASW community in the ability to utilize environmental knowledge of the oceans to their advantage in ASW. ASW sonar technicians are inadequately trained in environmental effects on underwater sound propagation. To increase the oceanography knowledge of all enlisted personnel including STs and to provide enlisted ratings to better utilize training in environmental effects, several programs are proposed. These programs include an ASW sensor rating and an oceanography rating.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENT

The author wishes to express his appreciation to the officers and enlisted men of the fleet who willingly contributed to this study through their responses to the opinion surveys. The author is sincerely grateful to Dr. Dale F. Leipper and LCDR C. K. Roberts for their support and assistance in this study.

I. INTRODUCTION

In 1962, the Oceanographer of the Navy, Rear Admiral E. C. Stephan, stated in a lecture delivered at the Naval War College, that "perhaps the greatest current problem in oceanography is the matter of education" [1]. RADM Stephan further stated, "We will not do what the country needs us to do in oceanography if we don't foster an awareness, an interest, and curiosity in a plebe entering the Naval Academy or an enlisted man entering the service. This is our medium. We either know it or we don't know it. If we know it, we can be of tremendous service to the country. If we don't, we will never fulfill our potential" [1]. The oceans provide the environment in which naval forces must live and operate. The medium represented by the oceans is a dynamic one. To satisfactorily operate in this dynamic medium, we must have knowledge and understanding of the continuing changes which occur.

There is a widespread relationship between oceanography and naval operations. The applications of oceanography to naval operations involve air, surface and subsurface activities. Anti-submarine operations, submarine operations, mine and mine counter-measure operations, and amphibious operations are the primary areas of concern. The oceanographic factors related to naval operations will be discussed further in Section II.

Of the foregoing areas of naval operations, antisubmarine warfare (ASW) is the single one having the most urgent problems involving naval oceanography [2]. Oceanography is associated closely with antisubmarine warfare, because the performance of ASW systems is controlled by the ocean environment to a greater degree than are other systems employed in naval warfare [3]. Detailed knowledge of the medium in which ASW will be waged "must be second nature to Navymen from skippers to acoustic sensor operators" [2]. The surface and submarine sonar technicians and the air-borne antisubmarine warfare operators are the enlisted sensor operators who normally must be relied upon to operate the sensors in the actual environment.

In the past ten years since RADM Stephan stated that the greatest current problem in oceanography was the matter of education, how far has the Navy progressed in educating navymen in oceanography? While obtaining data for this study, a naval officer who occupies a billet requiring knowledge of sonar technician education and training requirements was noted as stating: "Sonar technicians are not involved with oceanography anymore." The executive officer of a destroyer stated: "He was not qualified to comment on the relationship of ASW and oceanography." The problem of education still exists.

In 1964, it was decided that not all education and training should be concentrated at the officer level. It was believed that the field of oceanography had then reached

that level of importance and application at which serious consideration was being given to the formation of a corps of enlisted men trained in oceanography. The Aerographer's Mate (AG) rating was considered the logical one to take on these additional responsibilities "since the laws of physics which govern meteorological phenomena also govern oceanographic phenomena." It was then stated: "The additional training in oceanography will produce a highly skilled and valuable man who can make a most useful contribution to the success of naval operations. This cadre is required to maintain an oceanographic capability among naval personnel" [4]. Thus the impetus was provided for the education and training in oceanography for the AG rating.

The Navy has made large investments in ASW hardware in the past several years and is continuing to budget heavily for the research and development effort in ASW. In an article published in February 1972, Dr. Robert R. Mackie, an authority in ASW human factors research declared: "Significant improvement in ASW readiness and systems performance is achievable if we are willing to make an investment in the upgrading of the human element in these systems. The amount of improvement may well be as great or greater than that obtainable through major investments in improved hardware" [5]. One of the large investments in ASW hardware, the multi-mode AN/SQS-26 sonar, has been operational in the fleet for about eight years, but only in the past two years have the long range modes been getting the attention they

require. Environmental training has contributed to the understanding of the phenomena involved in using these modes [6].

This study is concerned primarily with perusal of current enlisted training and education in applied oceanography. From this study, proposals for modification of existing programs were made. An important area, which was not included in the study, is Navy training requirements to support new undersea technologies. An exploratory investigation has been made to develop and employ valid bases in forecasting likely effects of new technology on future Navy training requirements [7]. This investigation forecasts that future developments in undersea technologies will profoundly affect Navy training requirements during the next two decades. Additionally, the report recommends a study in detail of all current and future Navy and national oceanic and deep-ocean programs, and development of updated long-range personnel and training implications. Thus, the way must remain clear for future training requirements in oceanography to support these new technologies.

The purpose of this study is to attempt to answer the following questions.

1) Does the Navy require specific ratings, in addition to the Aerographer's Mates, which are especially trained in oceanography?

2) How much knowledge of the environment does the sensor operator need to properly perform his duties? Should

the operator's training be limited to plugging operator's handbooks, graphs, charts, and slide rules, or, should he also have a knowledge of the principles correlating the sensor system to the actual environment?

3) Could enlisted ratings trained in oceanography be assigned at the staff level or on ASW capable ships for the support of ASW operations where billets for officers trained in oceanography are not provided?

4) Which enlisted ratings require training in oceanography and at what level?

5) What are the present levels of oceanography training and education available to enlisted personnel and what is the oceanography content of the subject matter?

The answers to the above questions will hopefully also help to answer other related questions and to provide ancillary information concerning enlisted education, training, and advancement.

A. METHOD OF STUDY

The method of approach to this study was as follows:

1. Literature searches were conducted of pertinent subject areas applicable to this study to obtain reports, directives, studies, and publications for background information.

2. The Manual of Qualifications for Advancement [8] was reviewed to determine the current qualification items which are oceanography oriented.

3. An opinion survey was prepared and forwarded to the executive officers of randomly selected Helicopter Anti-Submarine Squadrons (HS), Air Anti-Submarine Squadrons (VS), and Patrol Squadrons (VP) concerning the adequacy of oceanography-oriented training for enlisted personnel in their squadrons.

4. An opinion survey was prepared and forwarded to executive officers of randomly selected mine warfare and ASW capable ships concerning the oceanography training of sonar technicians.

5. A detailed sonar technician survey form was prepared and forwarded to the sonar technicians assigned on board mine warfare and ASW capable ships. The survey form included personal history information, training information, and an opinion survey of the formal Navy training received in 25 subject areas related to oceanography.

6. School curricula and curricula outlines were requested from training commands offering training in oceanography and oceanography related areas.

7. Telephone conversations and personal interviews were exchanged with officers in training commands offering training in oceanography and oceanography related areas.

8. Navy rate training manuals were reviewed to determine the oceanography content available for reference in Navy enlisted correspondence courses.

9. Sources of oceanography education which are currently available or could become available to enlisted personnel were reviewed.

10. The data obtained from the literature searches, surveys, school curricula, and other sources were then compiled to ascertain the requirements for enlisted education and training in oceanography, and to determine if the present state fulfills these requirements.

B. GLOSSARY

A glossary of terms is provided in Appendix A. It consists of terms peculiar to enlisted training, education, manpower, and advancement.

II. OCEANOGRAPHY AND NAVAL OPERATIONS

> Oceanography may be defined as the study of the oceans in all their aspects. The oceans and their bounding media are considered as a unified dynamic system, the study of which may be approached from the points of view, and with the techniques of, the various pertinent basic sciences [9].

Understanding underwater sound requires a consideration of the properties of the environment and a knowledge of acoustics. There must be an interpretation of physics in the environment. If gains are to be made in ASW, the environmental information from oceanography research must be integrated with the results from underwater acoustic research through the appropriate use of engineering principles. Progress will not be made at a satisfactory rate unless equipment or systems personnel and environmentalists interact to a common goal of ASW operational effectiveness [10].

Oceanography is not the panacea for ASW, but it must be utilized to obtain knowledge of the oceans because as previously mentioned the performance of ASW systems is controlled by the ocean environment to a greater degree than are other systems employed in naval warfare [3]. ". . . one effort must precede those of the acoustician, electronics man, and operator alike: the uncovering of basic knowledge of the sea itself. It is there that we must look in order to appreciate both our dilemma and our peril" [11]. The variability of the ocean dynamic system can produce large variations over both local and broad areas. Under certain

conditions, sensor systems can be rendered virtually useless due to the variability of the ocean environment. Fleet sensor operators must be aware of the existence and nature of these variations.

For example, experiments conducted at the Naval Electronic Laboratory tower in San Diego, California have shown that a change of 12 db in the sound pressure level can occur with the passage of an internal wave. A fluctuation of this amplitude would presumably cause a 24 db variation in the strength of the signal received by an active sensor, since two-way transmission is involved [12]. Also, sensor operators must be aware of the possibilities of extremely strong gradients in the vertical thermal structure as in the north wall of the Gulf Stream where the thermocline gradient is normally greater than 10°F per 100 feet of depth.

Soviet oceanography research is being vigorously pursued all over the world as part of a massive program to learn more about the oceans. Their first Seven-Year Plan in oceanography started in January 1959. The high priority for obtaining underwater acoustic data in this huge state-backed program has been clearly indicated [13].

> The nation that knows the most about the oceans and the qualities of the sea that govern the transmission paths for various forms of energy, and can thereby perceive how best to exploit them, will possess an immeasurable and probably crucial advantage [11].

A. OCEANOGRAPHY SUBDIVISIONS RELATED TO NAVAL OPERATIONS

From the military point of view oceanography can, and does, make a vital contribution to all aspects of naval

operations, but especially to antisubmarine warfare. In World War II, with operating conditions of 300-foot submerged depth for submarines; detection ranges of a few thousand yards (at best); weapons such as torpedoes, depth charges, or hedgehogs with a range of a few yards; it was not necessary to know much about the ocean medium [14]. With the advent of the nuclear submarine, and with the rapid increases in all types of technology, the need for improving the knowledge of the ocean environment became apparent. Longer ranges in sonars and weapons systems have greatly increased the effects of the environment on the performance of these systems. Antisubmarine warfare involves the use of air, surface, and submarine forces, hence most ASW environmental requirements overlap the requirements for other types of warfare. Ocean current measurements, for example, are of importance to ASW but also of importance to mine warfare, amphibious landings, carrier strikes, and replenishment at sea. Underwater acoustics in an oceanographic factor affecting practically all areas of naval operations. In Section I, it was stated that antisubmarine operations, submarine operations, mine warfare operations, and amphibious operations were primary areas of concern. In ASW, the emphasis is placed upon those characteristics of the environment which influence detection. In submarine operations this emphasis is accompanied by an equivalent concern with factors such as tides, currents, and water opacity that directly affect the tactics which may be effectively executed [15].

There are interrelationships among oceanographic phenomena which affect naval warfare. For example, in the area of under-water acoustics, the path which sound travels through the ocean is affected by temperature, salinity, and pressure variations along that path. Additionally, the sound energy may be influenced by biologic populations causing scattering and reverberation. The nature of the bottom can cause reverberation or the bottom can be used, as in bottom bounce propagation, to enhance unfavorable sound conditions.

The general subject areas affecting Naval operations that fall within the four basic subdivisions of oceanography, physical, biological, chemical, and geological, will now be briefly discussed [16].

1. <u>Physical Oceanography</u>

The scientific study of marine physics produces results applicable to almost all areas of naval operations. The optimum conduct of surface operations requires knowledge of the sea state at present and in the immediate future. Waves influence any surface movement of ships and further the surface condition is important in ship control, replenishment, and amphibious operations. Navigation requires knowledge of currents, of the earth's magnetism, and possibly of its gravity field. Sea turbulence influences air operations, submarine detection, mine laying, mine surveying, and reconnaissance. Thermal structure is the primary factor affecting sound velocity in the upper ocean areas. Temperature also affects the rate of fouling and corrosion on

ships and structures immersed in the sea. Submarine operations require a knowledge of the vertical and horizontal density distribution for trimming purposes. Geomagnetic and gravity fields affect navigation and ordnance operation.

2. Chemical Oceanography.

The chemical composition of sea water influences corrosion of ships' hulls and other equipment exposed to sea water. Salinity is an important factor influencing sound velocity in water. Also, certain chemicals seriously affect the absorption of sound in water.

3. Biological Oceanography

Marine fouling can seriously limit ship's speed and impair sonar performance. False biological targets cause a loss of time and effort, and in a wartime situation, a large expenditure of ammunition. Bioacoustics is important whenever sound discrimination is essential in the identification and classification of targets. Biological organisms cause scattering and reverberation. The safety of underwater swimmers is partly dependent upon the frequency of occurrence of noxious creatures.

4. Geological Oceanography

The shape and depth of the ocean basins, the land forms that surround these basins, and the discrete components of the ocean floor have impacts on naval operations [16]. Prior consideration must be given to geological configurations before equipment can be implanted on the ocean floors. Information on bearing strength of sediments, rate-of-sound travel through bottom deposits, and occurrence of rocky

reflecting surfaces or sound-absorbing muds is necessary for efficient emplacement. The features of coastal land forms vary around the world and must be examined for amphibious assault planning. For mine warfare, it is essential that information be available concerning the nature of the bottom. Knowledge of mud, sand, silt, ooze, and rock bottoms is important for the support of minecase anchors or the mines themselves. Bottom currents cause ripples or crevices on the bottom into which currents may cause a mine to "walk." Bottom vegetation may grow rapidly enough to contribute to mine fouling.

B. ENLISTED RATINGS REQUIRING TRAINING IN OCEANOGRAPHY

In order to ascertain the enlisted ratings requiring training in oceanography, the Manual of Qualifications for Advancement [8] was reviewed to determine the current qualification items which are related to underwater acoustics and oceanography. From this review, ten ratings were selected. It was further found that eight of the ratings could be classified as falling into the areas of sensor operators, forecasting and prediction, weapons effectiveness and delivery, and training simulators, although two of the selected ratings could not be precisely classified into these categories. (The applicable scope of each selected rating and the qualifications pertinent to this study are listed in Appendix B. The selected Navy Enlisted Classification (NEC) codes for these ratings are contained in Appendix C.)

For the purposes of this study only, the ten ratings were divided into primary and secondary ratings. The primary ratings were included in the current education and training study. The secondary ratings were not. Comments concerning each rating are presented in the following sub-sections.

1. Sensor Operators

Sensors used for detection, classification, localization, and tracking of submarines include active and passive sonars, Magnetic Anomaly Detection (MAD), and radar, working in a very complex ocean environment [17]. Sonar, active and passive, is the most important sensor for antisubmarine warfare. Sonars are designed for several modes of underwater sound propagation. The effectiveness of the modes for any given piece of equipment and in any given situation depends on the detailed characteristics of the immediate ocean environment. These characteristics vary with location and with time at any given position. Hence, the detection and classification ranges of a particular sonar system may vary considerably from one time to another and from one location to another. Sensor operators must understand and exploit these characteristics to make ASW forces as effective as possible. The enlisted sensor operator ratings who must have this understanding are: Aviation Antisubmarine Warfare Operator (AW), Ocean Systems Technician (OT), Radarman (RD), and Sonar Technician (ST).

2. Forecasting and Prediction

The availability of predictions of environmental parameters is extremely important. The Antisubmarine Warfare Environmental Prediction Services (ASWEPS) program consists of: (a) development of instrumentation for use aboard ships, aircraft, and buoys to measure oceanographic parameters, (b) development of thermal structure analyses, prediction techniques, and displays, and (c) application of the products to ASW planning and tactical operations [18]. ASWEP makes it possible for an operational area commander to obtain predictions and forecasts of conditions in his area. In addition to ASWEPS, sea, surf, and ice forecasting are very important to naval operations. The enlisted rating concerned with ASWEPS, sea, surf, and ice forecasting is the Aerographer's Mate (AG).

3. Weapons Effectiveness and Delivery

Oceanography factors effect underwater weapon effectiveness and delivery (including weapon sensor systems). The two enlisted ratings concerned with this aspect of oceanography and weapons are Mineman (MN) and Torpedoman's Mate (TM).

4. Training Simulators

The rating concerned with the operation and maintenance of sensor operator training simulators and devices is Tradevman (TD).

5. Other Ratings

Two additional ratings which cannot be precisely classified in the foregoing categories are Quartermaster (QM) and Aviation Antisubmarine Warfare Technician (AX). The oceanographic qualifications for these two ratings are contained in Appendix B.

III. CURRENT ENLISTED TRAINING IN OCEANOGRAPHY

The primary duty of the Navy in peacetime is training. In the past, the training of naval personnel has been the responsibility of numerous commands reporting through variations of command lines. However, the problem of not having a single training organization has recently been rectified.

A. NAVAL TRAINING ORGANIZATION

On 1 August 1971, a new command, Chief of Naval Training, was established at Pensacola, Florida. The Chief of Naval Training has the responsibility for surface, sub-surface, and aviation training. The organization of the new command is shown in Figure 1. The Chief of Naval Training has the responsibility for bringing all technical training for the Navy under central control. The schools, formerly managed by the Bureau of Naval Personnel, have been divided into four categories as shown in Figure 1. These schools will operate through a closely integrated fleet-training establishment relationship. Mission oriented schools, such as destroyer, submarine, and mine warfare, report directly to the technical training command as do the significant interest schools such as recruit training, damage control, and service schools. The mission oriented school heads report for additional duty to the appropriate type commander which assures the type commander technical direction over the

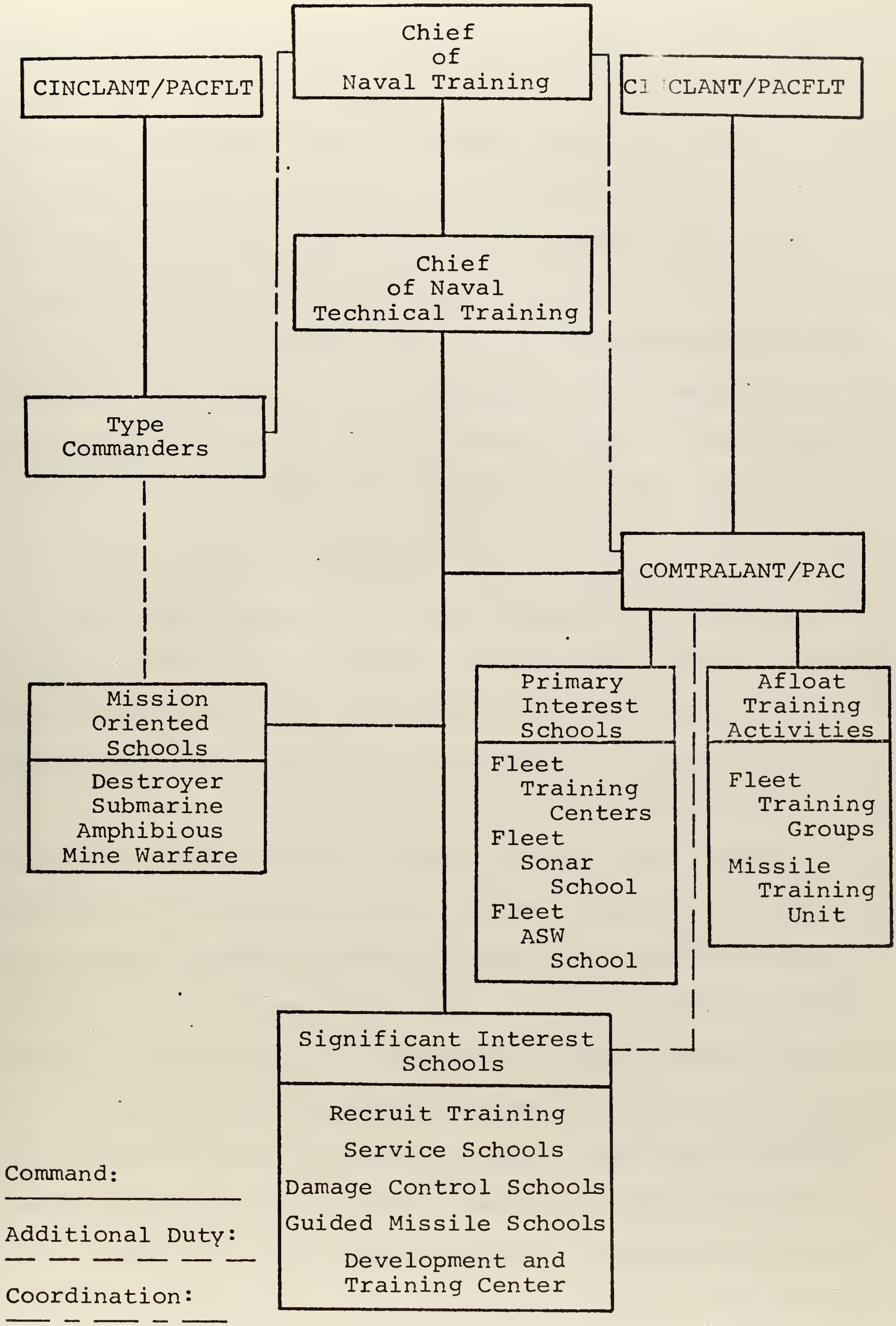

Figure 1. Naval Training Organization [19].

specialized nature of the curriculum of the schools. The Commanders, Training Command Atlantic (COMTRALANT) and Pacific (COMTRAPAC) report to their respective fleet Commander-in-Chief as well as to the Chief of Naval Technical Training. The afloat training activities and primary interest schools (Fleet Training Centers, Fleet Anti-Aircraft Warfare Training Centers, Sonar and Anti-submarine Warfare Schools) report directly to COMTRAPAC or COMTRALANT as appropriate. The significant interest school heads report to COMTRAPAC or COMTRALANT for additional duty [19].

B. GENERAL ENLISTED TRAINING

The basic reference for the preparation of training courses, training publications, on-the-job training programs, and school curricula is the Manual of Qualifications for Advancement [8]. The principle sources of professional training for enlisted personnel are the rate training manuals, correspondence courses based on rate training manuals, and training school courses. The Navy Training Publication Center at Memphis, Tennessee, produces rate manuals and correspondence courses for the various aviation ratings in the Navy. The non-aviation rate training manuals and correspondence courses are produced by the Navy Training Publications Center, Washington, D.C. The Naval Correspondence Course Center at Scotia, New York, administers and distributes all of the correspondence courses and prepares others not directly related to rating manuals. The Naval

Training Equipment Center, Orlando, Florida is the major government activity developing and procuring simulators for training.

C. ENLISTED TRAINING IN OCEANOGRAPHY FOR SELECTED RATINGS

In order to determine the status of training in oceanography currently available for the six primary ratings determined in Section II as requiring this training, a perusal was conducted of school catalogs and other school information. Rate training manuals, as listed for these six ratings in the List of Training Manuals and Correspondence Courses, NAVPERS 10061-AE, were also investigated for oceanography content. A listing of rate training manuals, study guides, and correspondence courses may be found in Appendix E. The number of training school courses ranges from very few for some ratings to a myriad of courses for other ratings. The major courses which the ratings included herein are eligible to attend are presented in Appendix F. This is a representative, but not an all-inclusive list.

The results of the study of currently available oceanography training are contained in the following sub-sections.

1. Military Training in Oceanography

A reply received from the recruit training command, as a result of an inquiry into the recruit training curriculum content, determined that no training in oceanography or oceanographic related subject matter was included in the recruit training curriculum nor planned for the near future. However, the military standards for advancement listed in

Appendix B include standards for Environmental Pollution Control for all naval personnel. A recently published rate training manual, Military Requirements for Senior and Master Chief Petty Officer, contains information pertaining to pollution control. Military Requirements for PO 1 & C contains information concerning the Navy's role in marine research.

2. Occupational Training in Oceanography

The rate training manuals, technical school catalogs, and curriculum outlines were studied for oceanography and oceanography related training applicable to the primary ratings of Aerographer's Mate (AG), Aviation Antisubmarine Warfare Operator (AW), Ocean Systems Technician (OT), Quartermaster (QM), Radarman (RD), Sonar Technician (ST), identified in Section II as requiring training in oceanography. The synopsis of these studies for each of the six ratings is contained in this sub-section.

a. Aerographer's Mate (AG)

The AG 1 & C rate training manual contains subject material pertaining to the study of the physical properties of sea water, their measurement and distribution; Optimum Track Ship Routing (OTSR); the observation, forecasting, and effect of land and sea ice on naval operations; and sea, swell, and surf forecasting. This material is important to the AG due to his role in the determination and forecasting of oceanic factors affecting naval operations. The rate training manual contains more information and study

material on the ocean environment and the Antisubmarine Warfare Environmental Prediction Service (ASWEPS) than any other unclassified rate training manual. The Naval Weather Service, with technical aid from the Naval Oceanographic Office, provides acoustical forecast products for all oceanic areas. The knowledge of sound propagation theory and the effects of the ocean environment is necessary for an understanding and application of these products to ASW operations. For this reason, the AG 1 & C rate training manual contains study material on sonar principles, instrumentation systems, and analysis procedures. The material includes principles of active and passive sonar; propagation of sound in sea water, sound velocity, gradients, factors affecting transmission; underwater ray paths, shallow water transmission, deep water transmission; mechanical bathythermographs (BT), expendable BTs, reading and interpreting BT traces, recording and distributing BT data, airborne radiation thermometers (ARTs); and the application of oceanographic products. Additionally, the manual contains information on ocean currents since they vitally affect the weather. Sea waves, swell waves, and surf observations are topics included in the AG 3 & 2 manual.

There are three primary training school courses for the Aerographer's Mates which contain oceanography as a phase of the course: Class A, Class B, and the Class C Air-Ocean Environment Course. The schools are located at the Naval Air Technical Training Center, Lakehurst, New Jersey.

The classes of schools are defined in Appendix A. In the Class A school, the trainee must acquire an elementary understanding of the subject of physical oceanography and develop skill in decoding and plotting oceanographic data on appropriate forms, charts, and diagrams. He must also acquire an understanding of the type, nomenclature, operating principles, use, operator's care, and maintenance of non-electronic and selected electrical oceanographic instruments. The oceanography phase is 35 instructional hours divided into three units. The outline of the oceanography phase is as follows:

Unit 1 - Physical Oceanography ------------ 12 hours

Introduction to Oceanography
The Physical Oceans
Physical Properties of Sea Water
Characteristics of Sound
Sound Ray Theory
Oceanic Circulation

Unit 2 - Instruments and Logs ------------- 6 hours

Oceanographic Instrumentation
Oceanographic Logs and Codes
Oceanographic Data Evaluation

Unit 3 - Oceanographic Charts ------------- 17 hours

Routine Oceanographic Services
Tailored Oceanographic Services
Application of Products

The stated objective of Aerographer's Mate Class B school is to provide the comprehensive background necessary for the performance and administration of duties in the Naval Weather Service, and for advancement in rating to AG1 and AGC. To accomplish this objective the trainee must acquire basic knowledge of sea, swell, and surf forecasting, acquire

a basic knowledge of the properties of sea water and their effect upon naval operations, and acquire an understanding of the physical and chemical properties of sea water and their effects on sound transmission. He must become proficient in the analysis and forecasting of environmental oceanographic data, and develop skill in converting environmental data into range data for various types of sonar, and preparing these conversions in a format appropriate for operational use. The oceanography phase of Class B school occupies 160 instructional hours. The oceanography phase outline which is presented below is divided into three units.

Unit 1 - Basic Oceanography ---------------- 35 hours

Introduction to Military Oceanography
Properties of Sea Water
The Oceanic Heat Budget
The Mixing Theory
Oceanic Circulation
Basic Principles of Sea Waves and Swell
Determination of Effective Fetch
Forecasting Sea and Swell Waves
Basic Principles of Surf
Forecasting Surf
Sea Condition Analysis
Land and Sea Ice
General Oceanography

Unit 2 - Oceanographic Analysis and Prediction ------------------------ 35 hours

Oceanographic Instrumentation
Oceanographic Data Evaluation
The Gulf Stream
Sea Surface Temperature Analysis
Layer Depth Analysis
Drift Analysis
Ocean Thermal Structure Forecasting
Forecasting Thermal Structure

Unit 3 - Application to ASW ---------------- 90 hours

Characteristics of Sound
Ray Path Tracing
The Sonar Equation
Major Sound Transmission Paths
Acoustic Properties of Sea Water
Sonar Systems and Tactics
NAVSHIPS Range Prediction Method
Graphic Range Display
Variable Depth Sonar Range Prediction
Sonobuoy Range Prediction
Submarine Sonar Range Prediction
Tactical Application (Laboratory)
OPAREA Forecast
Acoustic Sensor Range Prediction (ASRAP)
Ship Helicopter Acoustic Range Prediction System (SHARPS)
Airborne Oceanography
Oceanographic Support Service
New Developments in Oceanography

The objective of the Air-Ocean Environment course, Class C, is to provide selected enlisted naval personnel with the understanding and knowledge necessary to fulfill the technical and operational requirements of the Naval Weather Service Command's Antisubmarine Warfare Environmental Prediction Service (ASWEPS). To accomplish this objective, the student must acquire a basic understanding of the physical and chemical properties of sea water and of their effect on underwater sound. Likewise, he must gain a general knowledge of the equipment used to measure the physical properties of sea water, with emphasis on devices for measuring temperature versus depth. He must acquire a working knowledge of bathythermograph observations, become adept in the plotting and analyzing of local-area sea-surface temperature, layer depth, current drift and

sea-condition charts. He must also gain a general knowledge in the conversion of environmental data into range data for various types of sonar and in the preparation of these conversions in a format appropriate for operational use. The course is divided into three phases. Phase I, Fundamentals of Sea Water and Sound, is 48 instructional hours divided into three units. The Phase I outline of training is as follows:

Unit 1 - Physical Oceanography ------------- 20 hours

- Introduction to Military Oceanography
- Physical Oceans
- Sea Water Temperature
- Salinity
- Pressure
- Density
- Water Masses and Types
- Ocean Currents
- Marine Climatology

Unit 2 - Underwater Sound ------------------ 15 hours

- Characteristics of Sound
- Sound Ray Theory
- Shallow Water Transmission
- Deep Water Transmission
- Ray Path Tracing
- The Passive Sonar Equation
- The Active Sonar Equation

Unit 3 - Observational Equipment and Procedures ------------------------ 13 hours

- Bathythermograph Systems
- BATHY Log and Code
- Airborne Radiation Thermometer
- Augmenting Oceanographic Equipment
- Evaluation of Bathythermograph Traces

Phase II, Environmental Analysis and Prediction, covers 42 hours divided into four units: sea surface temperature charts - 10 hours, layer depth charts - 10 hours, augmenting oceanic environmental charts - 10 hours, and

thermal structure forecasting - 12 hours. Phase III, Operational Analysis and Prediction, is 70 hours divided into four units: acoustic sensor systems - 8 hours, range prediction methods - 24 hours, oceanographic services - 6 hours, and environmental application laboratory - 32 hours.

b. Aviation Antisubmarine Warfare Operator (AW)

The AW 3 & 2 and AW 1 & C rate training manuals contain study information concerning underwater sound theory, ocean environment principles, the Antisubmarine Warfare Environmental Prediction Service, and other oceanographic related items of study pertinent to the AW rating. For security reasons, the precise contents of the manuals are not presented.

The primary training school for the AW rating is the Class A school located at Naval Air Technical Training Center, Naval Air Station, Memphis, Millington, Tennessee. The Class A school is 16 weeks in length and includes principles of oceanography and principles and types of acoustic and non-acoustic ASW equipment. The curriculum has recently undergone revision and the curriculum unit on oceanography to be taught in the new, revised course of instruction is outlined as follows:

Phase II, Unit 1 - Oceanography ------------ 40 hours

TITLE	HOURS
Introduction to Oceanography	3
Geological Oceanography	2
Air-Ocean Interface	2

Physical and Chemical Properties of Sea Water	4
Biological Oceanography	3
Logarithms	4
Decibels	4
General Theory of Underwater Sound	5
The Sonar Equation	3
ASWEPS	2
ASWEPS Tactical Application	3
Review and Examination	5

Until recently, Fleet Aviation Specialized Operational Training Group (FASOTRAGRU) Pacific conducted a three-day basic oceanography course for AWs, and FASOTRAGRULANT conducted a five-day enlisted ASW oceanography course. These courses have been discontinued as an efficiency measure. However, the FASOTRAGRUs will probably continue to teach oceanography to acoustic AW operators as a portion of another training syllabus. FASOTRAGRULANT has compiled a manual, Oceanography for Air Anti-Submarine Warfare. The manual is presented in two parts, one unclassified and one classified. As stated in the manual's preface, the authors have attempted to present the minimum amount of information necessary for air ASW personnel to make intelligent and timely decisions when faced with the task of searching for and localizing submarines. It is an excellent compliation of oceanography material and a very useful reference. Although not all-inclusive, the authors state: "It is further hoped that the

information presented in this two part manual will serve to whet the appetite of those personnel involved, and that they will go on with a more determined effort to learn more about the ocean environment."

c. Ocean Systems Technician (OT)

There are neither rate training manuals nor correspondence courses available for Ocean Systems Technicians. A study guide for OTs is available. The primary OT training school is the Class A Ocean Systems Technician School, located at the Fleet Sonar School, Key West, Florida. The purpose of this course is to train selected personnel to perform basic watchstanding duties at an oceanographic naval facility. The course includes instruction in the operation of the naval facility equipment, data collection, data analysis, and practical applications to oceanographic system shore equipment.

d. Quartermaster (QM)

The QM 1 & C rate training manual contains subject matter on oceanographic observations, echograms, reports to the Oceanographic Office; sea and swell observations, wind waves, swell, wave parameters, breakers, surf; ice observations, characteristics of ice, ship-shore ice log; and charts and publications. The QM 3 & 2 rate training manual contains study material on the topics of tides and currents, tide tables, predicting set and drift, and weather.

There is no Class A nor Class B school established for Quartermasters. The Fleet Training Center at

Newport, Rhode Island conducts a five-week Quartermaster Course which includes in the curriculum, instruction on navigational charts and publications, and weather observation and reporting. Fleet Training Center, San Diego, California, has an established four-week Basic Quartermaster course which includes instruction in charts and related publications, weather, and tides and currents. Additionally, a one-week course, Piloting and Publications, is conducted at the same activity. This course includes instruction in types, procurement, uses, and stowage of navigational charts and publications.

e. Radarman (RD)

The RD 3 & 2 rate training manual contains information on charts, chart numbers, oceanographic publications, and chart correcting. Information on ASW operations and the recording of ASW data is contained in the RD 1 & C manual.

The basic Radarman training school is the Class A school located at the Service School Command, Great Lakes, Illinois. The Class A school includes antisubmarine warfare in the curriculum, but there is no training provided in environmental factors affecting ASW in the curriculum. An advanced course for Radarman, Operations Specialist, is established at the Fleet Anti-Air Warfare Training Center, San Diego, California. The purpose of this course is to provide the advanced knowledge and skills required to perform as a specialist in naval warfare operations. The curriculum includes antisubmarine warfare. A lesson entitled

"Environmental Factors" is contained in the course of instruction. This lesson includes information on the physics of sea water, sound refraction, temperature gradients, sound velocity profiles, sound propagation paths (less bottom bounce), the effect of weather on the operational aspects of ASW, and shipboard sonar range prediction techniques. There is no ASWEPS or SHARPS information included in the curriculum outline.

f. Sonar Technician (ST)

The ST 1 & C rate training manual is designed to present an overall look at the present field of anti-submarine warfare. It covers the tactics of ASW units working in the air, on the surface, and under the sea. The manual includes no subject matter concerning the theory of underwater sound or the ocean environment. As described in Appendix B, the ST general rating is divided into two service ratings: STG (surface) and STS (submarine), up to and including paygrade E-5. The STG 3 & 2 manual contain subject material pertaining to oceanography and range prediction. It includes information on range prediction, thermal gradients, layer effects, sound propagation paths, submarine operating depths, sea state, ray path plotting, bathythermograph observations, and oceanographic support. This manual was last revised in 1969. The acoustic theory and ocean environment study material included in it is minimal. The STS 3 & 2 manual was last revised in 1966, but contains more comprehensive study material on sound theory and the ocean

environment than the STG 3 & 2 rate training manual. The STS manual includes ambient noise, sea noise, biological noise, factors affecting sound paths, reverberation (surface, volume, bottom), spreading, attenuation, factors affecting loss of sound energy, temperature gradients, ocean currents, and sound propagation paths.

There is no training course, as a separate entity, in applied oceanography, underwater sound theory, or the ocean environment, available for sonar technicians. The oceanography, sound theory, and ocean environment factors information presented at the enlisted school level is an integral part of the ASW and mine warfare school curricula. The basic school for both the surface and submarine ST is Class A school, which is divided into two phases, A-1 and A-2. Sonar Technician Class A-2 schools are essentially electricity/electronic courses and are not considered in this study. The ST class A-1 (submarine) school is conducted at Fleet Sonar School, Key West, Florida, and Fleet ASW School, San Diego, California. The basic principles of underwater sound are contained in this curriculum, which includes sound wave propagation, sound velocity profiles, propagation paths, sound propagation losses, noises in the marine environment, and reverberation. The school has a total of 14 hours instruction in underwater sound and seven hours on the topic of active/passive sonar equations. ST Class A-1 (surface) school is taught at the same two activities as Class A-1 (submarine). The Class A-1 (surface)

school curriculum contains 15 hours on the principles of sound in sea water, including marine biology and bottom topography, physics of sound and doppler drills, acoustic ray theory, reverberation, propagation paths, figure of merit, bathythermographs, and range prediction (SHARPS System). The Class A-1 (surface) school is divided into an eight-week core phase and a 2-6 week operation phase. Fleet ASW School, San Diego, provides courses in the operation of the AN/SQS-35 Independent Variable Depth Sonar, AN/SQS-26 BX and CX Sonars, which include the basic principles of physical oceanography and environmental effects upon equipment modes and parameter settings. The three courses are each two weeks in length and are a package of the Class A-1 (surface) school. Fleet Sonar School, Key West, has an AN/SQS-26AX(R) and CX operations course which is designed to provide STs with a background in the oceanographic aspects of deep water sound transmission in order to enable operators to employ all modes of operations of the sonars. Sonar performance prediction and oceanography are highly stressed as are hypothetical environmental ocean condition problems. Physical properties of sea water, reverberation, and background noise are also included.

An extensive course, Advanced ASW Systems Technology, has been established at Fleet Sonar School, Key West. The stated purpose of the course is to provide instruction in the application of advanced technological concepts to submarine and ASW tactics, and the operation of surface and submarine sonar and fire control systems to obtain optimum

performance under any ocean environmental and operational conditions. The course includes instruction in underwater acoustics, oceanography, ASW systems employment and tactics, and advanced contact classification. A lengthy course, Sonar AN/SQS-26BX Maintenance located at Fleet ASW School, San Diego, includes advanced oceanography, deep ocean sound propagation, techniques of bottom bounce and convergence zone, and contact classification. The AN/SQS-26CX sonar maintenance schools, taught at Fleet Sonar School, Key West, and Fleet ASW School, San Diego, list advanced oceanography as being included in the curriculum. The AN/SQS-35 maintenance schools, which contain theory of operation of the sonar, include the environmental effects on performance of the sonar system.

The sonar target classification (basic) course includes information to give the operator a better understanding of environmental conditions and their effects on sonar performance and target classification. Advanced classification school includes study of ocean phenomena and non-submarine sounds. Fleet ASW School, San Diego, has a short AN/SQS-26 BX/CX operator refresher training course available which provides instruction in parameter settings and environmental conditions by use of the 14E19 (AN/SQS-26 BX/CX Training Device). A two-day course in bathythermograph observations, and sonar range prediction is taught at the Fleet Training Center, Charleston, South Carolina. This course includes the basic physics of underwater sound

and range prediction using ray path plotting techniques, NAVSHIPS 900,196, and SHARPS. A one-day course, Sonar Range Prediction, located in Norfolk, Virginia includes instruction in oceanographic factors affecting ASW tactics, sonar range prediction using NAVSHIPS 900,196, ray path plotting techniques, range prediction using convergence zone slide rule, and SHARPS interpretation techniques.

Naval Schools, Mine Warfare, Charleston, South Carolina, conducts two courses for sonar technicians assigned to mine warfare ships. The UQS-1 Operator/Maintenance course trains mine warfare sonar technicians to operate the AN/UQS-1 sonar and includes instruction in the physics of sound, the effects of oceanographic phenomena, and ocean currents that effect minehunting operations. The AN/SQQ-14 Sonar Operator/ Maintenance Course provides basic instruction in the operation of the sonar system, operating procedures, and target classification.

For the submarine sonar technicians, General Submarine Sonar Maintenance School is taught at Fleet Sonar School, Key West. The school provides instruction for skilled sonar technicians in the operation and maintenance of sonar systems installed aboard SS, SSN, and SSBN submarines, including instruction in the passive sonar equation and the physics of sound in water. An advanced training course, Submarine Sonar Subjective Analysis, is available at four locations: Submarine School, New London, Connecticut; Naval Submarine Training Center Pacific, Pearl Harbor,

Hawaii; FBM Training Center, Charleston, South Carolina; and Fleet ASW School, San Diego, California. The oceanographic content of the course includes losses in the sound medium (divergence and attenuation), factors affecting sound velocity, reverberation and reflection, and sound propagation paths.

Other courses are available for sonar technicians and non-sonar technician watchstanders which include the basic physics of underwater sound. Additionally, sonar technician maintenance courses, particularly for submarine technicians, are available for training. COMTRALANT has available programmed instruction for the mechanical bathythermograph and the expendable bathythermograph for use in training sonar technicians.

D. OTHER ENLISTED TRAINING SCHOOL COURSES

Training of enlisted personnel in underwater demolition and amphibious reconnaissance involves a facet of oceanography to be described which is not contained in the other training courses. A description of this training follows:

1. Basic Underwater Demolition/SEAL Training

Training classes on certain aspects of beach and surf characteristics and marine life are included in basic underwater demolition/SEAL (BUD/S) training. The BUDS training conducted at the Naval Amphibious School, Coronado, California, includes the topics of beach terminology, ocean currents and current terminology, breaker and surf terminology, tide

and current tables, causes of tides, the use of portable fathometers, characteristics of coral and coral formations, beach intelligence and beach reports, surf reports, preparation of UDT hydrographic charts, and marine life.

2. Amphibious Reconnaissance Training

The amphibious reconnaissance training courses offered by Landing Force Training Command, Pacific, are open to enlisted personnel of the U.S. and Allied Armed Forces who satisfy the prerequisites for the training. The course lengths are one week, two weeks, and four weeks. Additionally, a 13.5-hour mobile training team presentation is offered for Organized Marine Corps Reserves serving in an Organized Marine Corps Reserve Reconnaissance Unit. The topics of the amphibious reconnaissance courses include baseline hydrographic surveys, hydrographic reconnaissance equipment, beach reconnaissance, surf observation and reports, hydrographic cartography, tide tables, hydrographic exercises, river/beach interpretation and reconnaissance, harbor sites, and map reading.

E. SOURCES OF TRAINING MATERIAL

In addition to rate training manuals, correspondence courses, and training schools and courses, there are other very valuable sources of training information in oceanography and underwater sound.

1. Training Films and Training Tapes

There are many excellent training films available on the subjects of oceanography and underwater sound. Training

films are listed in the Navy Film Catalog. Training tapes are available for use in training sonar technicians. Knowledge of the availability of training films and training tapes and methods of obtaining these training aids is a problem. The results of the sonar technician survey, described in Section V and Appendix D, indicates fleet sonar technicians are not receiving the tapes and films needed for shipboard training. This is primarily due to supervisory personnel, both officer and enlisted, not knowing how to obtain these training aids. This is a problem in communications and not in training.

2. Training Bibliographies

In addition to rate training manuals, there are numerous other publications available for study. These publications are listed in the Bibliography for Advancement Study, NAVPERS 10052-S. This bibliography lists the publications applicable for each rating by text identification number, correspondence course identification number (if applicable), and appropriate rate level. The rate training manuals and other publications listed may contain reading lists. Also, some of the textual material may refer to other publications for expanded coverage of the material.

3. Officer Correspondence Course Training in Oceanography

Enlisted personnel are eligible to enroll in officer correspondence courses. At the present time one officer correspondence course in oceanography is available, General Oceanography, NAVTRA 10417-A. The correspondence course is

designed to provide the student with an overview of, and an introduction to the field of oceanography. The course may be of general interest to enlisted personnel, but is of little use to fleet personnel seeking knowledge of the air-ocean environment and environmental effects on underwater sound propagation. The course includes only three questions concerning acoustics. In the sonar technician survey conducted in this study, only three of the technicians indicated completion of this correspondence course. The beneficial aspects of the course are best described by the comment of one ST: "General Oceanography course was good, but it didn't cover specific subjects that sonarmen would be interested in (sonarwise)." A second course, Oceanography in Antisubmarine Warfare, NAVPERS 10418, using as a textbook, Application of Oceanography to Antisubmarine Warfare, H. O. 781, was declared obsolete and discontinued in July 1972. The text, H.O. 781, is widely used for training but is seriously outdated having been published in 1961. There was no announced replacement for the correspondence course which was originally published in May 1963 and was never revised. However, H.O. 781 is under revision [20]. The ST survey results indicated five technicians had completed the course, but the course was too outdated to be of sufficient benefit to their training. A course is needed, for both officers and enlisted personnel, that relates applied oceanography to antisubmarine warfare.

IV. CURRENT ENLISTED EDUCATION IN OCEANOGRAPHY

In Section III, the organization of the newly established command, Chief of Naval Training, was described. The Chief of Naval Training is also the Director of Naval Education and Training (DNET) with headquarters in Washington, D.C. The Director of Naval Education and Training is OP-099 on the staff of the Chief of Naval Operations. The training requirements are provided the DNET Office by the Deputy Chiefs of Naval Operations Training Divisions for Submarines (OP-02), Surface (OP-03), and Air (OP-05). DNET combines the inputs and sets the priorities for the complete Navy education and training program. In order to properly coordinate the educational programs between the various schools and activities in the Navy, educational matters are now concentrated in one organization - DNET.

A. EDUCATION AND TRAINING ORGANIZATION

The organization of the Director of the Naval Education and Training Command is shown in Figure 2. The Education Programs Division, OP-993, administers and manages 18 educational programs within the Navy and in civilian schools. The Division is divided into three branches: Officer Education, Undergraduate Education, and Dependents Education. The Officer Education Branch manages special education programs, graduate education, the Naval War College, the Naval Postgraduate School, and certain Department of Defense

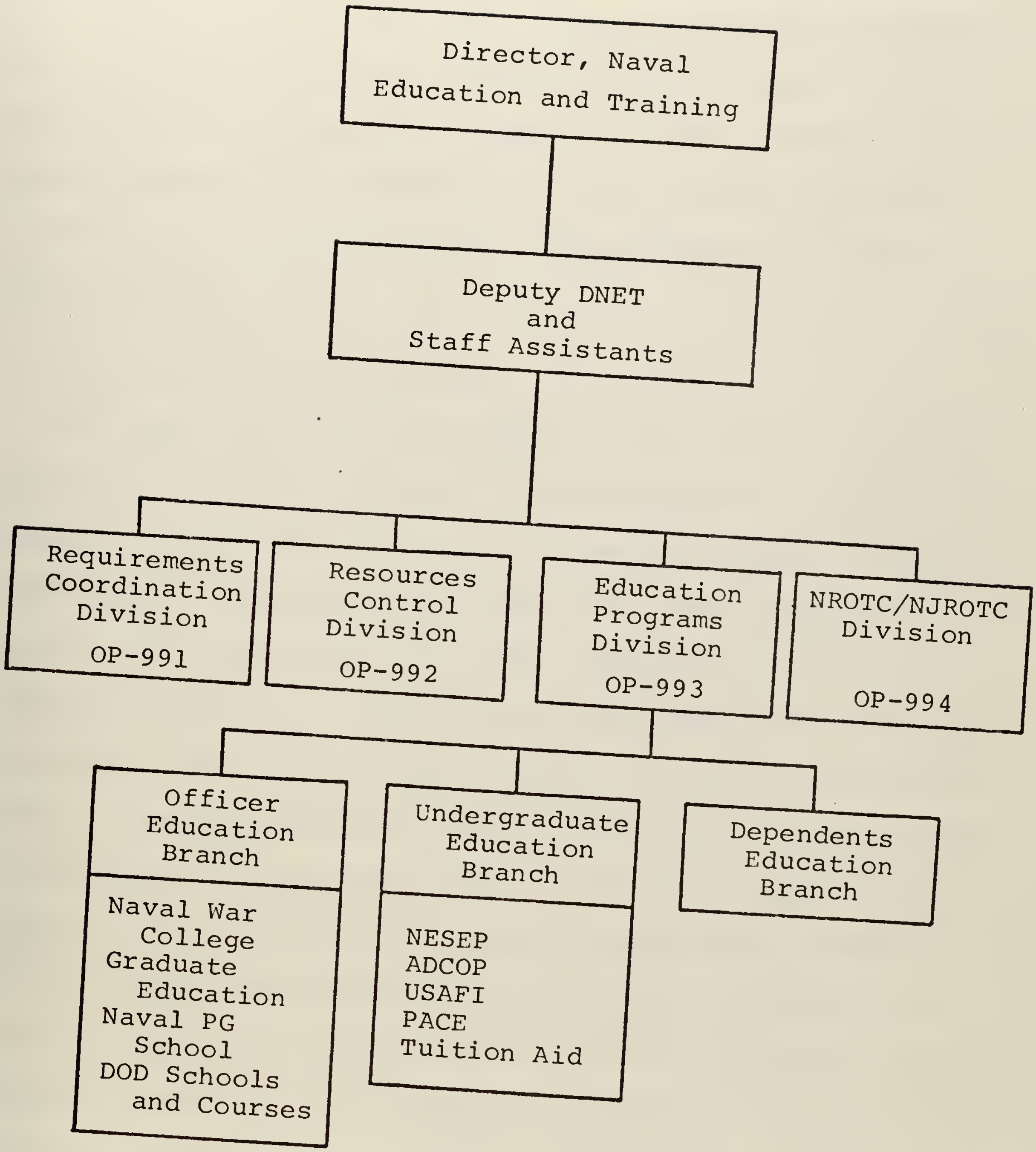

Figure 2. Director, Naval Education and Training Organization [21].

schools and courses. The Undergraduate Education Branch programs are: the Naval Academy, the Naval Academy Preparatory School, BOOST (preparatory school for minority members), Naval Enlisted Scientific Education Program (NESEP), the Associate Degree Completion Program (ADCOP), off-duty educational programs, the United States Armed Forces Institute (USAFI), the Program for Afloat College Education (PACE), and Tuition Aid [21].

B. GENERAL ENLISTED EDUCATION

The Educational Services Manual is the authority for the administration and operation of the educational services program at each Navy activity. The manual includes command requirements, procedures, and definitive and comprehensive guidance for each of the voluntary education programs in addition to details concerning the associated administrative procedures [22]. The purpose of the educational services program for enlisted personnel in the Navy is to insure (1) that all Navy enlisted personnel will be given the opportunity to earn at least a high school diploma or equivalent; and (2) that all career designated/career motivated enlisted personnel, who are properly qualified to pursue an advanced educational program, have an opportunity to continue their formal education leading to an associate degree. Meeting these objectives will raise the educational level of all active duty personnel, increasing their value to the Navy and to themselves.

In 1970, 38% of the Navy enlisted men were enrolled in one or more Navy sponsored education programs [23]. During the survey which determined this percentage of participation, enlisted men were asked to indicate the extent of their knowledge of selected Navy education programs. The men were most familiar, 98 percent, with USAFI correspondence courses, and about 70 percent with the Tuition Aid program. Only 39 and 36 percent, respectively, were familiar with the Program for Afloat College Education (PACE), and the Associated Degree Completion Program (ADCOP). These latter programs are apparently suffering from a lack of publicity [23]. The men also indicated that the opportunity for more Navy training was the most influential factor toward a Navy career. Off-duty educational opportunities ranked fifth as an influential factor.

C. ENLISTED EDUCATION IN OCEANOGRAPHY

The primary sources of enlisted education in oceanography are through the USAFI, PACE, Tuition Aid, and ADCOP educational programs.

1. United States Armed Forces Insitiute (USAFI)

The core of the education program is USAFI. Detailed information concerning USAFI is presented in the current edition of the USAFI Catalog, Correspondence Courses Offered by Colleges and Universities through the United States Armed Forces Institute, and the Educational Services Manual. There are three college level courses offered by USAFI which are

pertinent to the study of oceanography and underwater sound. These three courses are identified and described as follows:

A-510, Oceanography - 3 semester hours

This is an introductory course covering the fundamental physical, chemical, and biological features of the world oceans. It is comparable to courses normally offered to college juniors and seniors. The approach is nonmathematical, covering the topics from an introductory oceanography textbook.

C-505, General Geophysics - 3 semester hours

This is a comprehensive treatment of the fundamental concepts of modern geophysics. Included in the course topics are earth structure and composition, the hydrosphere, marine geophysics, the ocean floors, plate tectonics, submarine morphology, mid-ocean ridges, and the origins of mountains and continents.

D-517, College Physics I - 3 semester hours

This course is a study of the fundamental concepts underlying physical laws and relationships. Topics covered in the course include fluids at rest, fluids in motion, harmonic motion, wave motion, sound waves and sources, and atmospheric physics.

In addition to courses offered directly from USAFI, several courses are also offered by the USAFI Participating College and University Program. The student enrolls in correspondence courses offered by any one of a number of

colleges and universities under contract to USAFI. The following courses are presently available:

Course Number	Course Name	Quarter Hrs. Credit
XSB 105	Marine Geology University of California, Berkeley	4
C101	Survey of Oceanography University of Washington	5
(none)	Oceanic Navigation University of Tennessee	(none)

2. Program for Afloat College Education (PACE)

In cooperation with the Navy, several highly respected universities and colleges are under contract to administer a number of accredited undergraduate college-level courses to qualified men stationed aboard selected Navy ships [22]. The PACE program represents a part of the Navy's continuing effort to offer men opportunities to initiate and/or continue their formal college education while serving away from home. The details of the PACE program are contained in the Educational Services Manual. The courses available depend largely upon the geographic area and the participating college in that area. The actual course title, amount of credit earned, textbook requirements, and other supplementary information is provided by the college. The foregoing reasons preclude the listing in this study oceanography or underwater sound courses available under PACE. It was noted from the results of the sonar technician survey, described

in Section V and Appendix D, that one sonar technician had completed a course in oceanography administered under this program.

3. Tuition Aid

The objective of tuition aid is to provide eligible personnel with financial assistance as a means of encouraging their participation in the voluntary education programs at Navy approved institutions [22]. Educational institutions approved for Navy tuition aid are listed in the current edition of the Department of Health, Education, and Welfare's Education Directory, Part 3 - Higher Education. The Tuition Aid Program will pay up to 75% of school tuition costs, and will support up to seven credit hours, quarter or semester, in any one term. Details of the program are contained in the Educational Services Manual. Participation in oceanography courses, oceanography related courses, and underwater sound courses depends on the approved educational institutions located in the local area and the preference of the individual student as to his course of study.

4. Associate Degree Completion Program (ADCOP)

The Associate Degree Completion Program (ADCOP) offers career motivated enlisted members the opportunity to pursue a course of instruction at a participating junior college. This program leads to an associate of science/arts degree in various technical and vocational fields. Tuition and required educational expenses are paid by the Navy. The courses of study continue through the summer months, and the requirements for an associate degree are normally completed in less than

two years. Course planning and transfer of prior college credits are determined by the student in conjunction with the college counseling staff and the Navy administrative representative at the college. The student must pursue a field of study closely related to his rating and one which serves to increase proficiency in that rating. Six years obligated service are incurred in exchange for the opportunity to pursue the associate degree [24]. The pertinent details of the ADCOP program are contained in Bureau of Naval Personnel Manual.

Studies have been conducted to evaluate the career motivation value of the ADCOP program for enlisted personnel. These studies have shown the majority of the graduates of the program feel that ADCOP would have an advantageous effect on advancement opportunities and their ability to do a better job in their rating. Six out of 10 graduates hope to further their education by completing at least a bachelor's degree, and about 30% hope to complete at least a master's degree either in or out of the Navy. The ADCOP graduates have shown a definite positive attitude toward the program [25]. Recently the ADCOP program has been expanded to include a warrant officer ADCOP, and a trial run of an extension of ADCOP to allow previous graduates to work toward a bachelor's degree. The Chief of Naval Personnel has stated an ultimate goal of having 4500 enlisted personnel in junior colleges at one time.

A list of the junior colleges offering courses and associate degree in "marine sciences," including oceanography and ocean engineering, has been prepared [26]. The compilation includes several junior colleges with courses of study which would be closely related to the ratings identified in Section II. A course of study at these colleges, preferably a college where the program is designed so that students who attain an associate degree may transfer to a senior institution and pursue a bachelor's degree, would be beneficial. As the ADCOP program grows, consideration should be given to adding several of the junior colleges offering courses and associate degrees in marine sciences to those participating in the program.

V. SURVEY FINDINGS AND RECOMMENDATIONS

In order to obtain information for this study, three opinion type surveys of randomly selected fleet personnel were conducted. The surveys covered:

1. Sonar technicians
2. Ship executive officers
3. Aircraft squadron executive officers

The data, statistics and comments from the survey are contained in Appendix D.

A. FINDINGS

The survey findings are contained in the following subsections.

1. Sonar Technician Survey

The findings of this survey show the average age of the sonar technicians to be 23.8 years, with an average time in service of 4.8 years. The average civilian education level is 12.7 years, increasing, in general, from the higher to the lower paygrades. These averages all occur at approximately the E-5 paygrade level. In general, the sonar technician is young and relatively inexperienced. Approximately 50 per cent of the sample attended Class A school within the past three years and 75 per cent within the past five years. This means the majority of the sample attended Class A school under the A-1 and A-2 phase concept. The

majority, 67%, indicated favorable intentions to enroll in a voluntary course of programmed instruction in oceanography, if such a course was available. In order to further their education, approximately 50 per cent of those eligible indicated they would request the ADCOP program if an associate degree in oceanography or as a marine technician was offered.

The sonar technicians were requested to indicate their opinions concerning the adequacy of the Navy school training they had received in 25 subject areas covering the topics of sound propagation and oceanography. The list was representative and covered the major areas of interest. The list of subject areas and percentage of sonar technicians believing the subject area was covered inadequately in Navy training schools is contained in Table 1, ranked from lowest to highest percentage, by ship type. The information is presented graphically in Figures 3-10, with an additional breakdown for the destroyer type ships to distinguish between the AN/SQS-23 and the AN/SQS-26 hull-mounted sonar-equipped ships. Figures 11-18 show the relation of the percentage of destroyer sonar technicians believing the training to be inadequate as a function of paygrade and type of hull-mounted sonar.

From Table 1, it is evident the sonar technicians believe their school training in the temperature effects on the sound velocity profile was the most adequate, and the effect of internal waves on sound transmission was the least adequate. A notably high percentage of the total sonar

TABLE 1. PERCENTAGE AND RANK OF SONAR TECHNICIANS BELIEVING SUBJECT AREAS WERE NOT COVERED ENOUGH BY SHIP TYPE.

Subject Areas	Total		Destroyer		Submarine		Minesweeper	
	Rank	(%)	Rank	(%)	Rank	(%)	Rank	(%)
1. Temperature effects on the sound velocity profile.	1	19.6	1	19.9	1	13.6	3	33.3
2. Salinity effects on the sound velocity profile.	2	22.8	2	22.8	2	15.9	10	50.0
3. Pressure effect on the sound velocity profile.	3	25.6	3	25.9	2	15.9	10	50.0
4. Surface reverberation (sea state, wind, and waves).	4	30.3	4	30.8	4	27.3	1	25.0
5. Bottom reverberation (irregularities on the ocean floor).	5	36.6	6	37.6	6	31.8	1	25.0
6. Environmental conditions affecting scattering loss.	6	37.0	5	37.5	6	31.8	5	41.7
7. Environmental conditions affecting absorption loss.	7	40.2	8	41.8	4	27.3	5	41.7
8. Volume reverberation (including the Deep Scattering Layer).	8	40.8	7	41.0	9	38.6	5	41.7
9. Daily and seasonal variations in temperature conditions.	9	48.9	9	47.2	19	54.5	16	75.0
10. Shallow water sound transmission.	10	52.6	10	52.3	17	52.5	14	63.7

Subject Areas	Total		Destroyer		Submarine		Minesweeper	
	Rank	(%)	Rank	(%)	Rank	(%)	Rank	(%)
11. False targets.	11	53.0	11	53.9	16	48.8	5	41.7
12. Ambient noise (sea surface noise, thermal noise, rain noise, terrestrial noise, etc.)	12	53.3	12	56.2	8	34.1	5	41.7
13. Biological noise.	13	54.5	13	57.1	10	39.5	3	33.3
14. Bottom sediments and acoustic properties of the ocean bottom.	14	56.5	14	58.1	13	45.5	10	40.0
15. Convergence zone transmission.	15	58.2	17	60.0	10	39.5	16	75.0
16. Bottom bounce transmission.	16	59.5	16	59.7	18	53.5	16	75.0
17. Environmental conditions necessary for a surface duct.	17	60.7	18	61.4	14	46.5	21	91.7
18. Ray path plotting.	18	61.5	15	59.4	22	70.4	21	91.7
19. Causes of varied salinity conditions in the oceans and areas expected to find these conditions.	19	64.8	19	65.8	21	61.4	10	50.0
20. Environmental conditions necessary for a deep sound channel.	20	65.5	20	67.2	14	46.5	19	83.3

Subject Areas	Total Rank	Total (%)	Destroyer Rank	Destroyer (%)	Submarine Rank	Submarine (%)	Minesweeper Rank	Minesweeper (%)
21. Environmental conditions governing spreading (spherical, cylindrical, and dipolar).	21	66.2	22	68.5	12	40.9	21	91.7
22. Effects of marine fouling on sound transmission.	22	66.3	21	67.3	20	59.1	15	66.7
23. Topography of the ocean bottom (bathymetric features).	23	70.2	23	71.8	23	72.7	19	83.3
24. Locations and general characteristics of the current systems in the oceans.	24	80.4	24	80.1	25	81.8	21	91.7
25. Effect of internal waves on sound transmission.	25	81.2	25	81.4	24	77.3	21	91.7

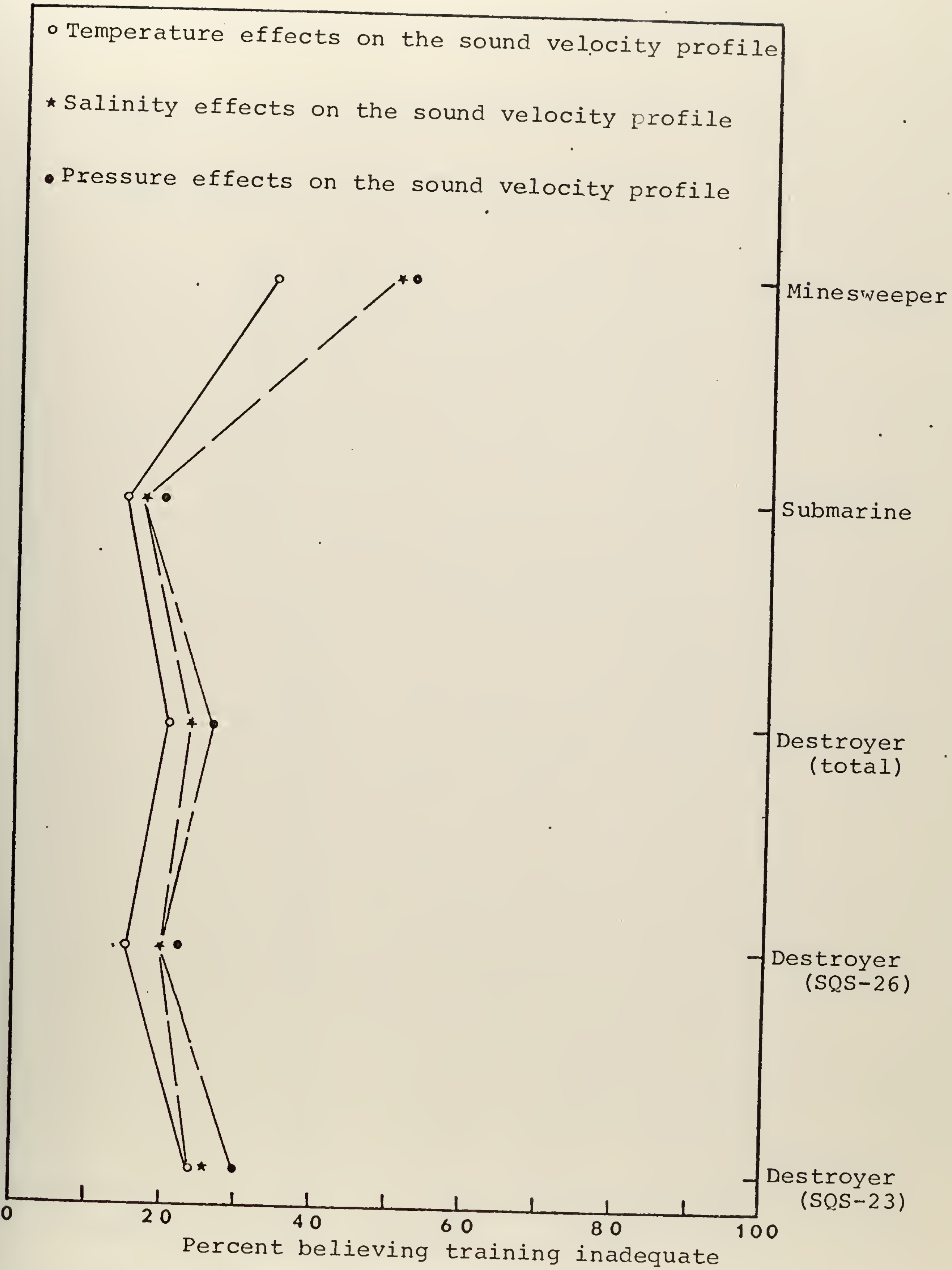

Figure 3. Relation of Inadequate Training to Subject Matter Topics, as a Function of Ship Type.

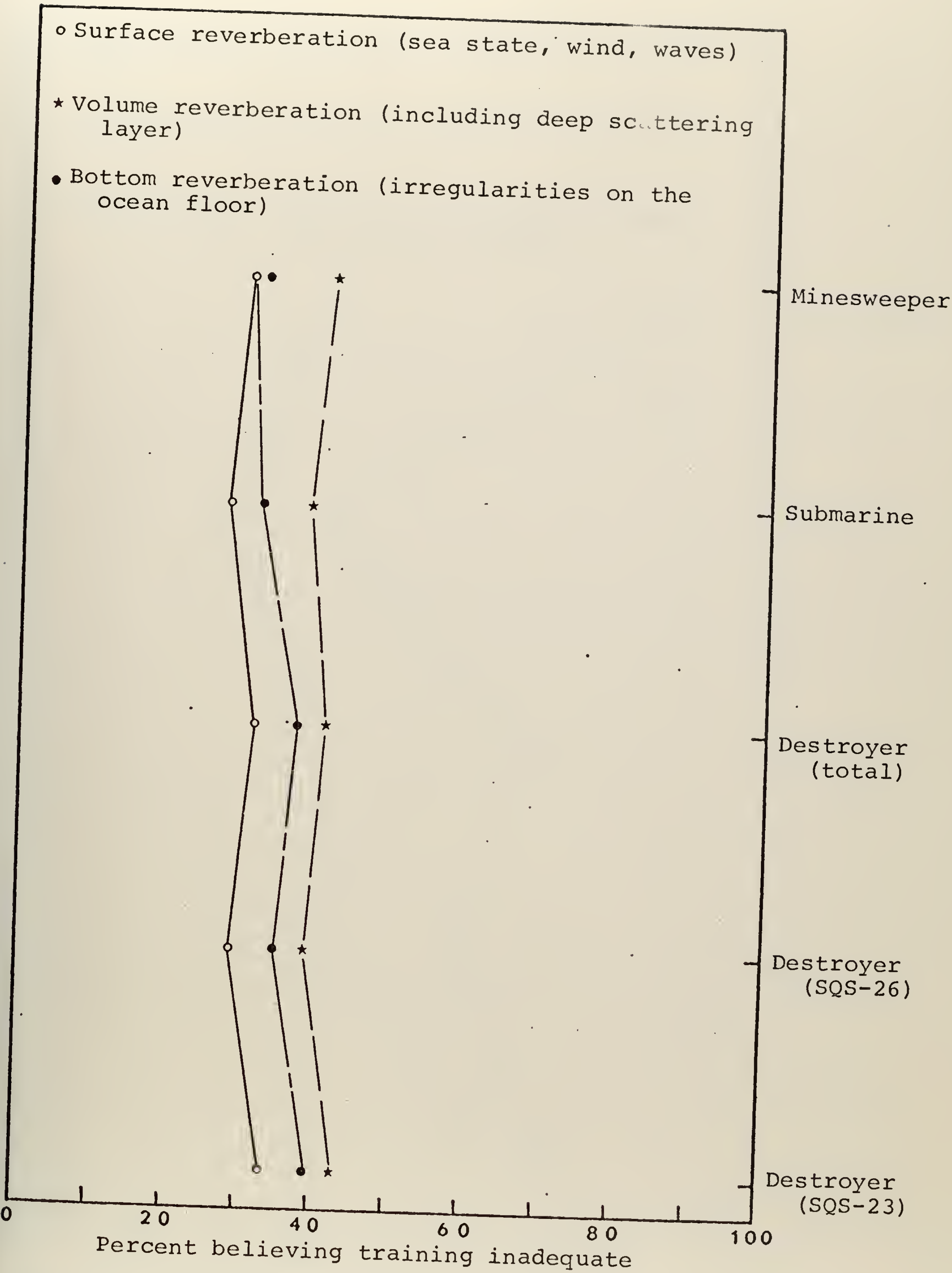

Figure 4. Relation of Inadequate Training to Subject Matter Topics, as a Function of Ship Type.

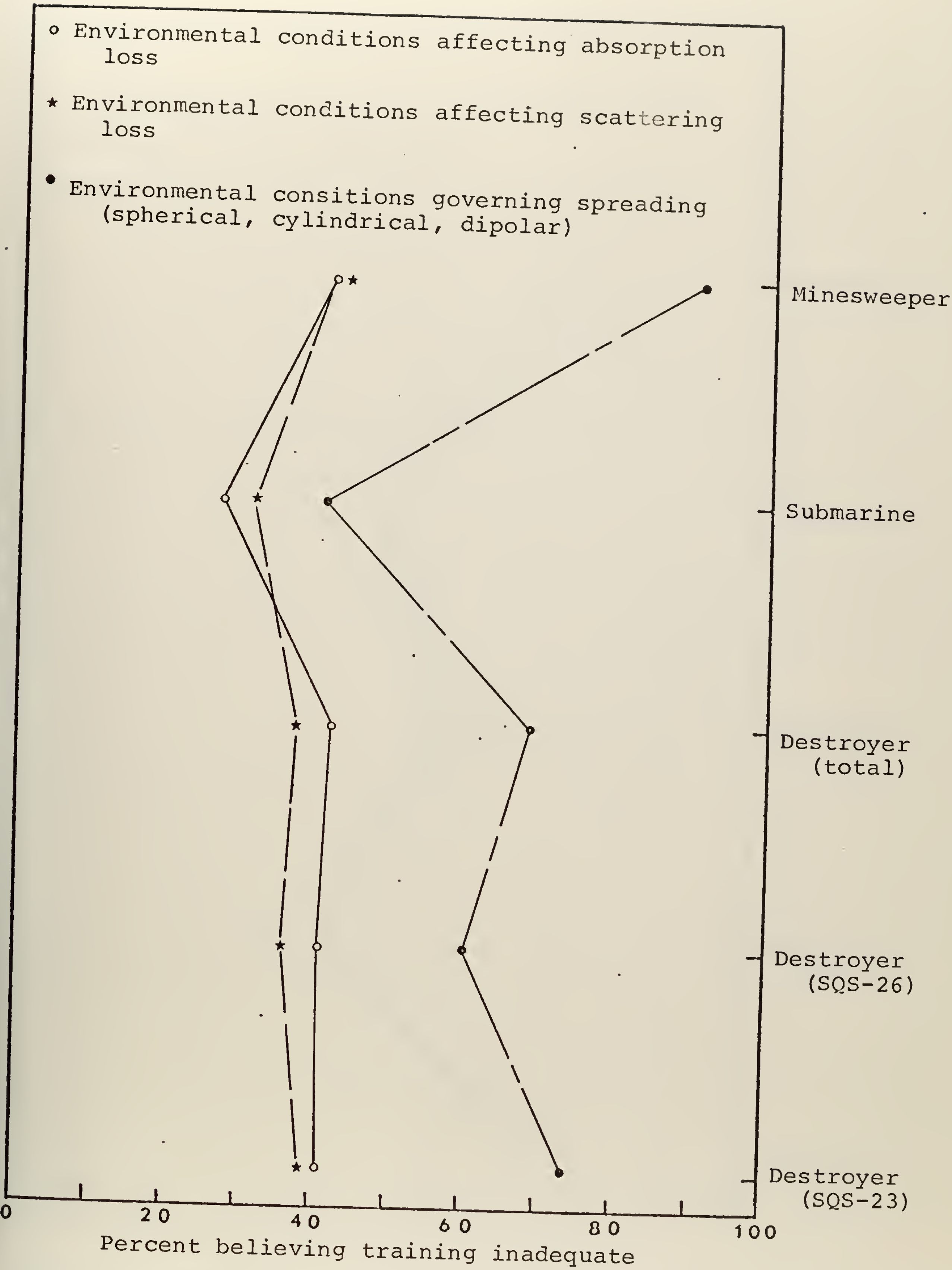

Figure 5. Relation of Inadequate Training to Subject Matter Topics, as a Function of Ship Type.

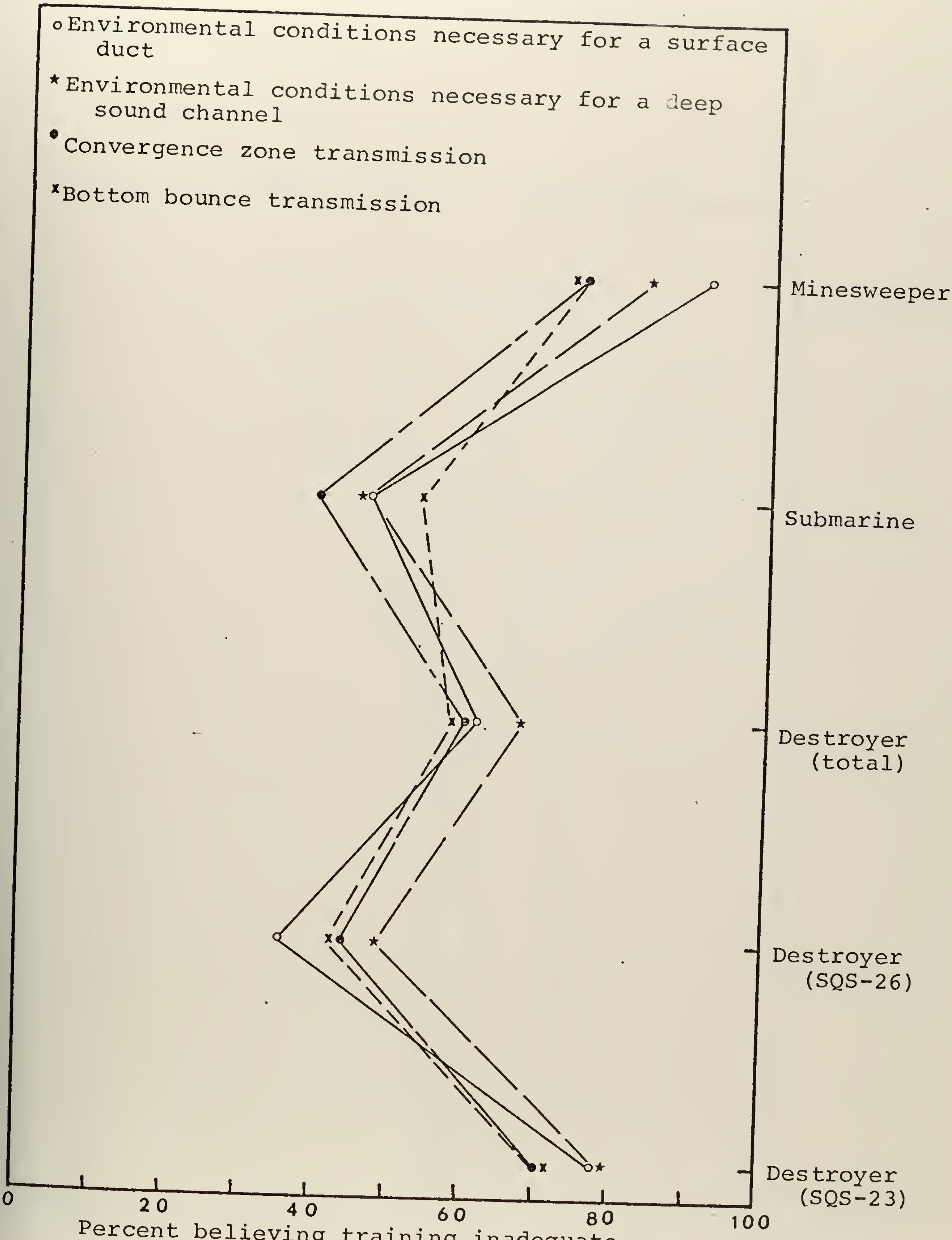

Figure 6. Relation of Inadequate Training to Subject Matter Topics, as a Function of Ship Type.

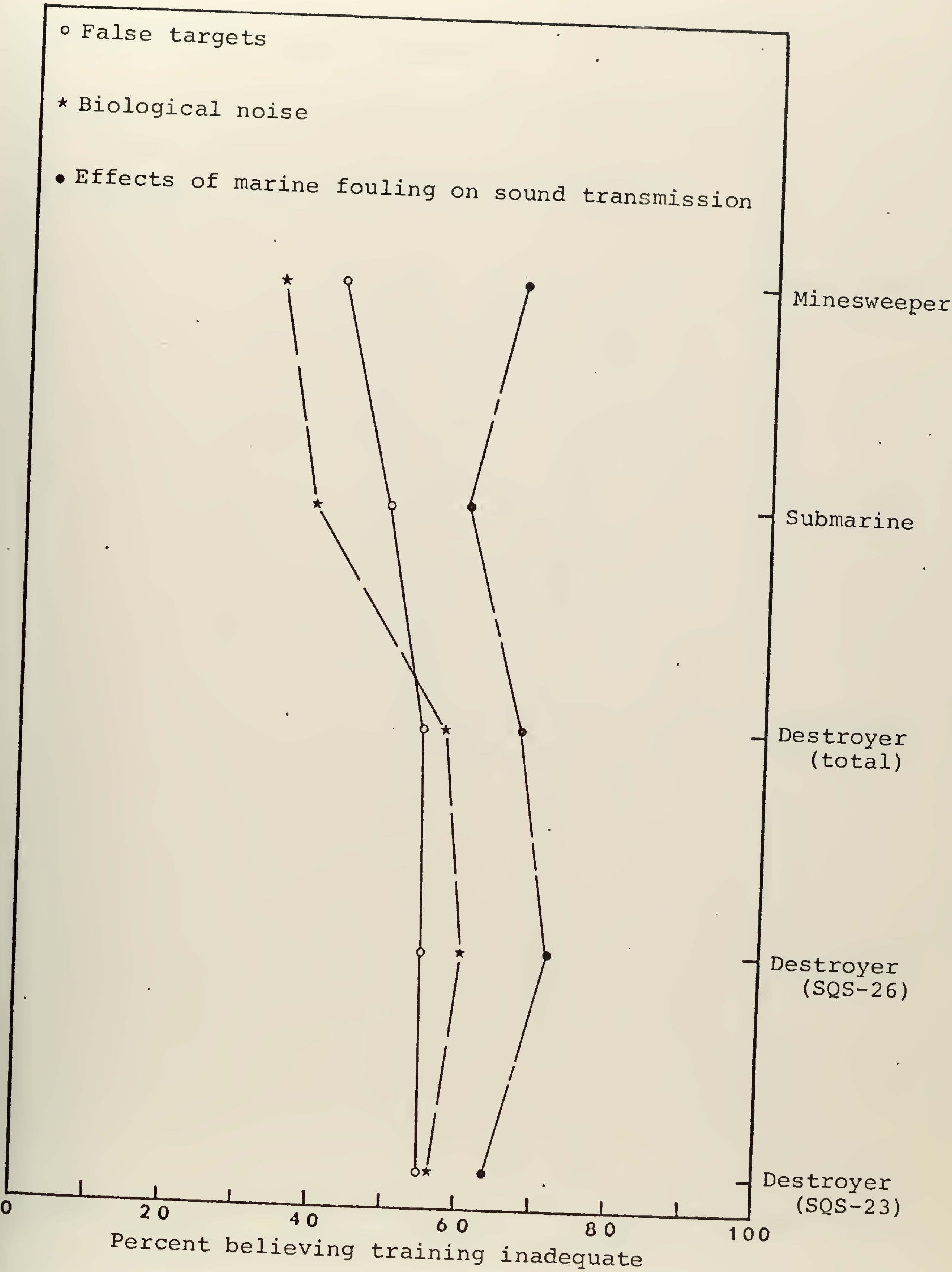

Figure 7. Relation of Inadequate Training to Subject Matter Topics, as a Function of Ship Type.

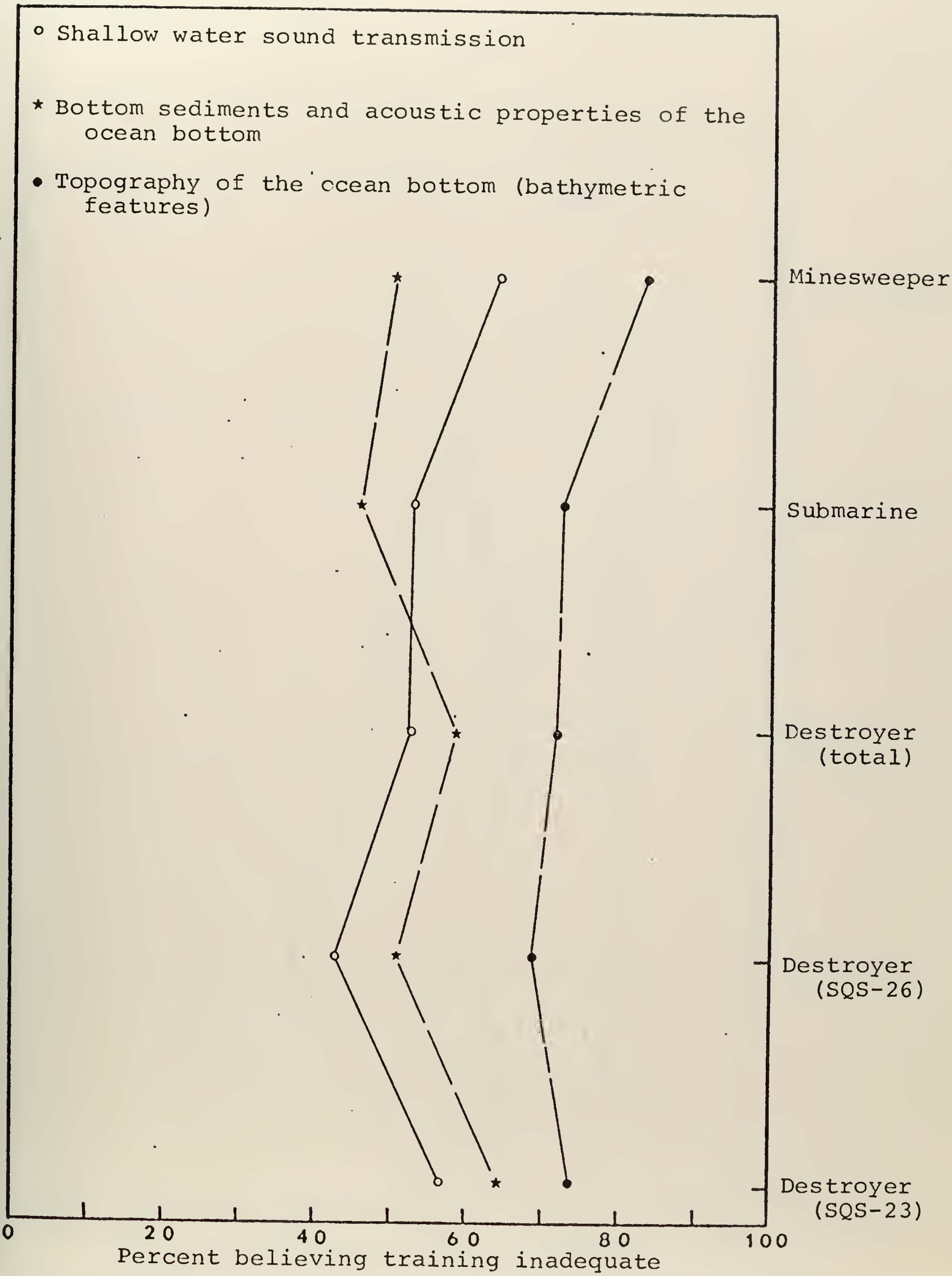

Figure 8. Relation of Inadequate Training to Subject Matter Topics, as a Function of Ship Type.

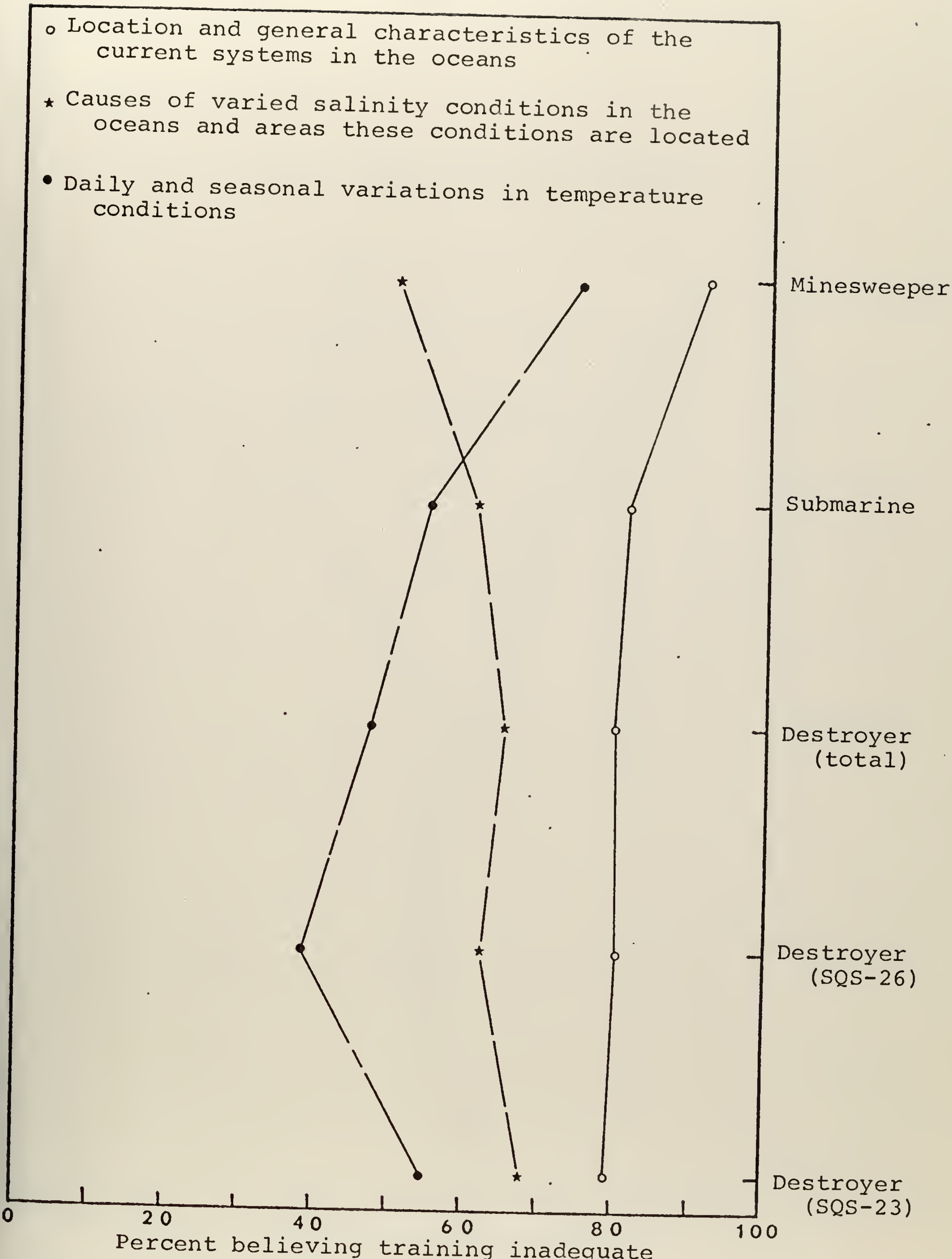

Figure 9. Relation of Inadequate Training to Subject Matter Topics, as a Function of Ship Type.

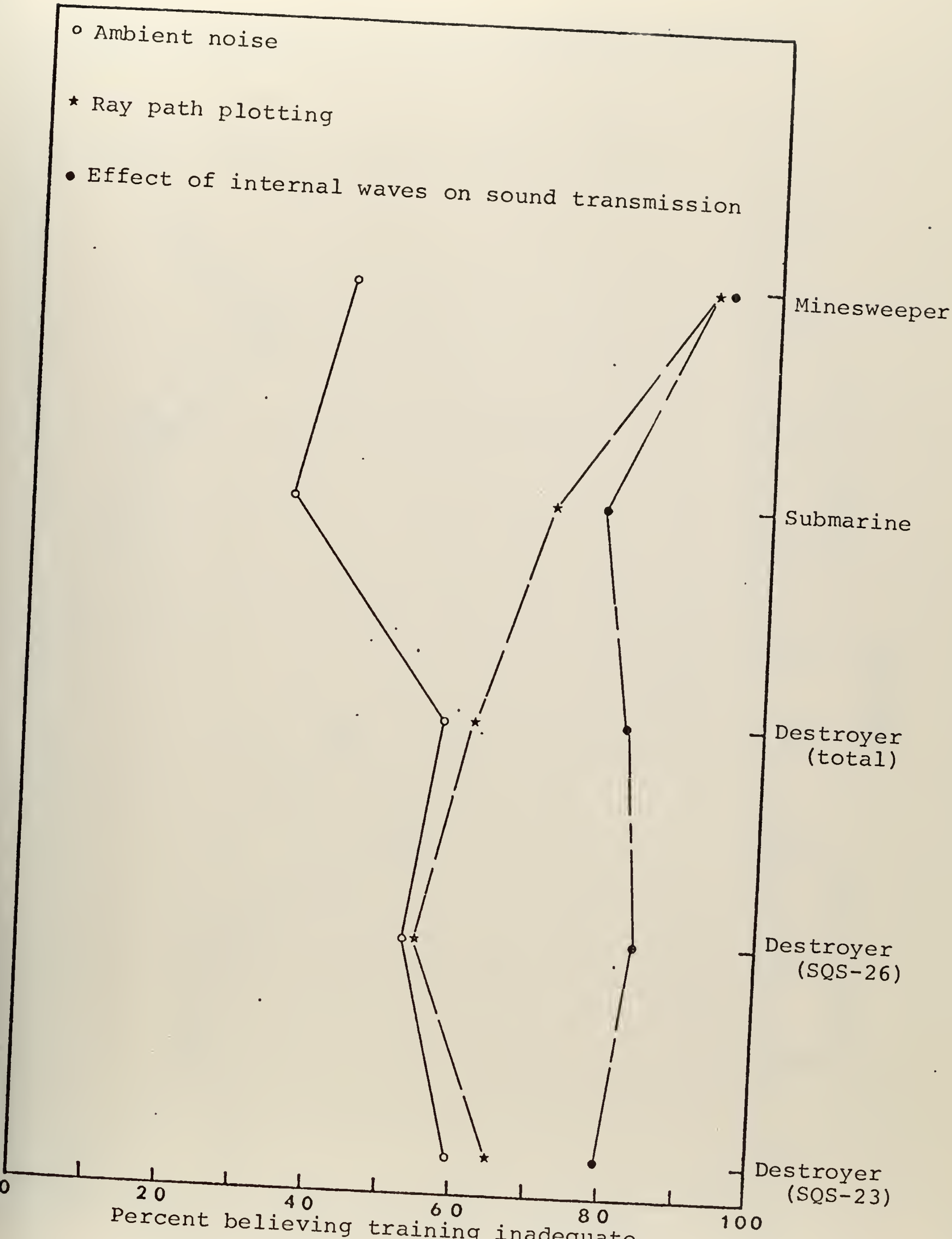

Figure 10. Relation of Inadequate Training to Subject Matter Topics, as a Function of Ship Type.

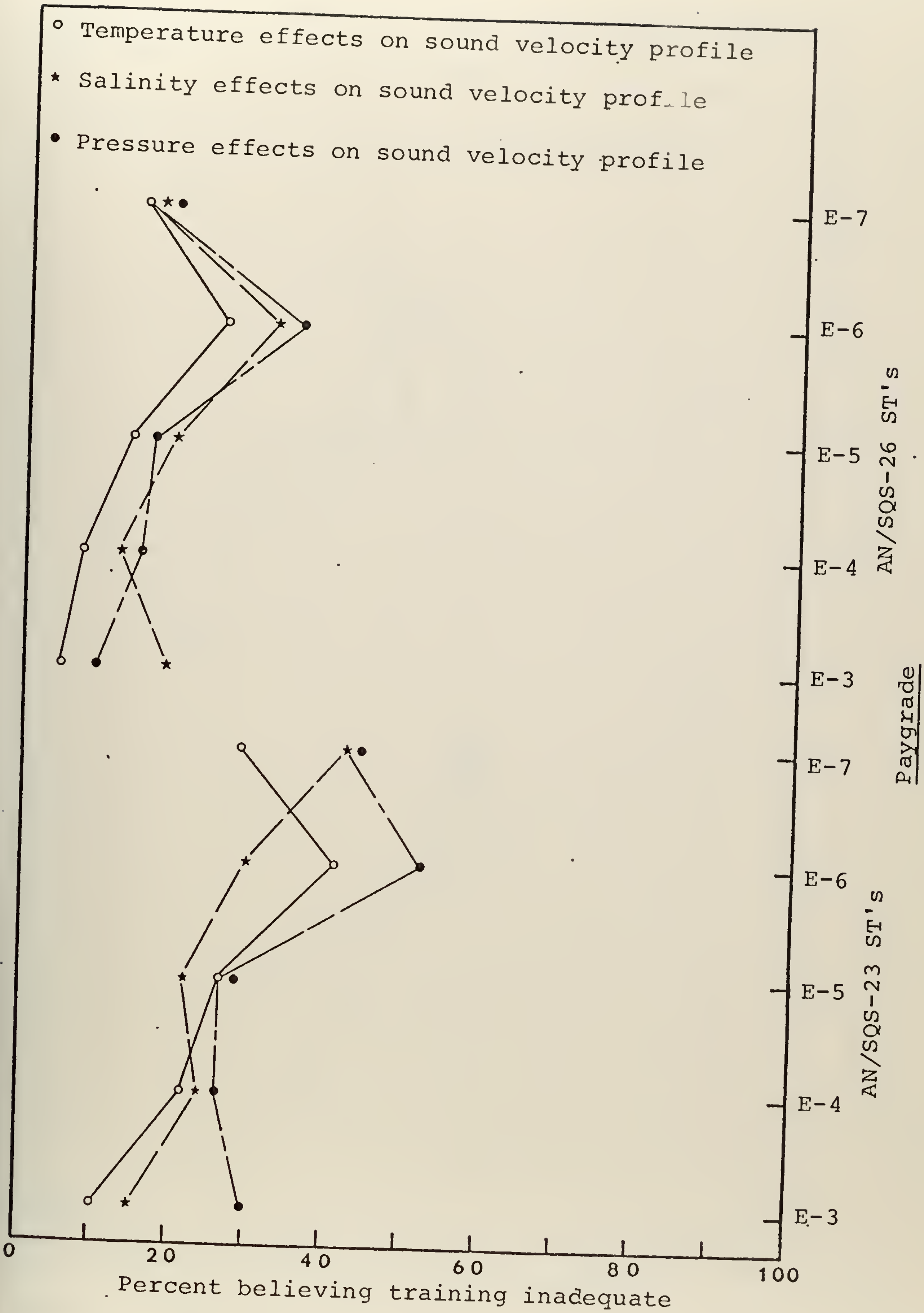

Figure 11. Relation of Inadequate Training to Subject Matter Topics, as a Function of Type Sonar and Paygrade.

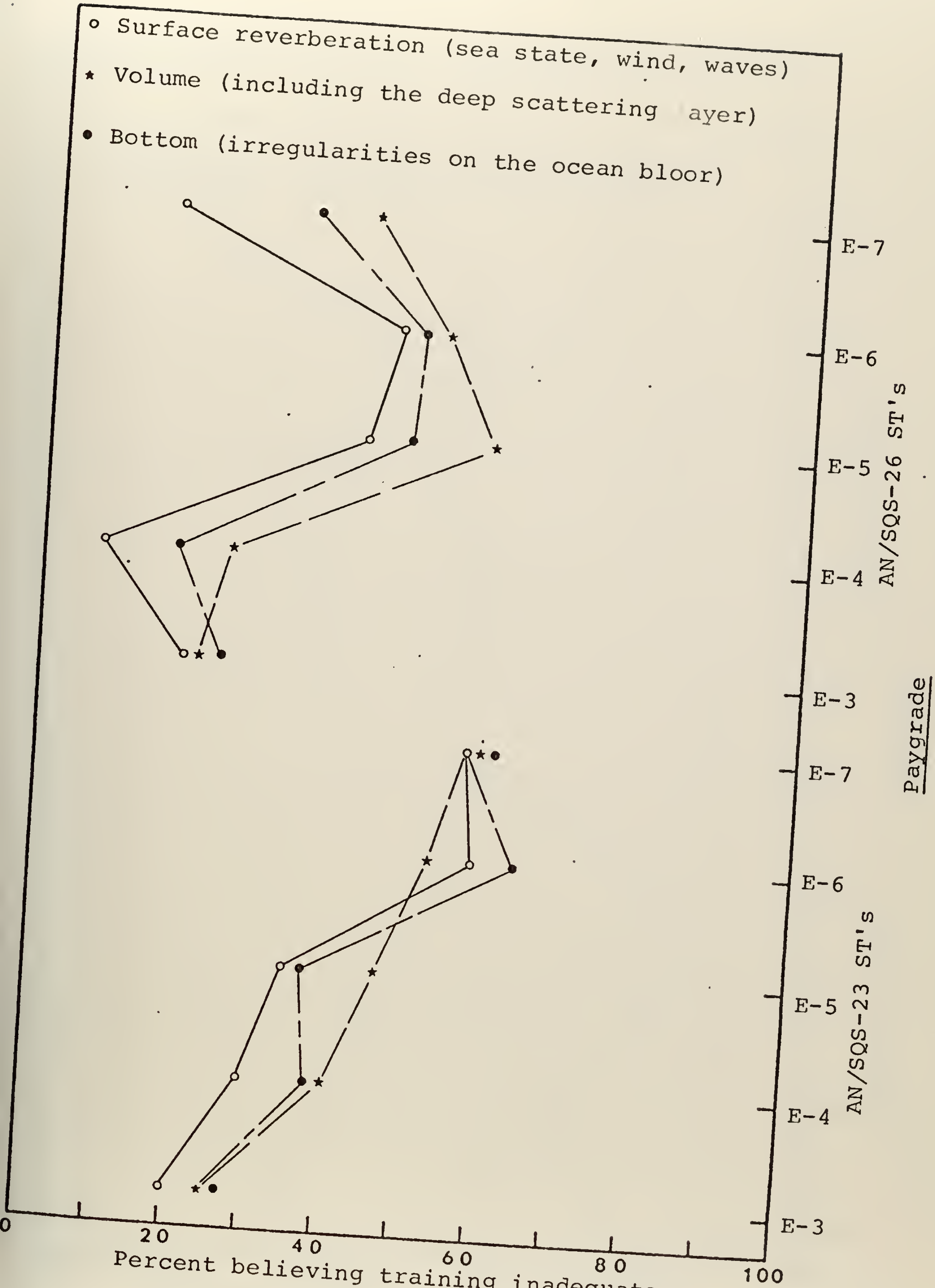

Figure 12. Relation of Inadequate Training to Subject Matter Topics, as a Function of Type Sonar and Paygrade.

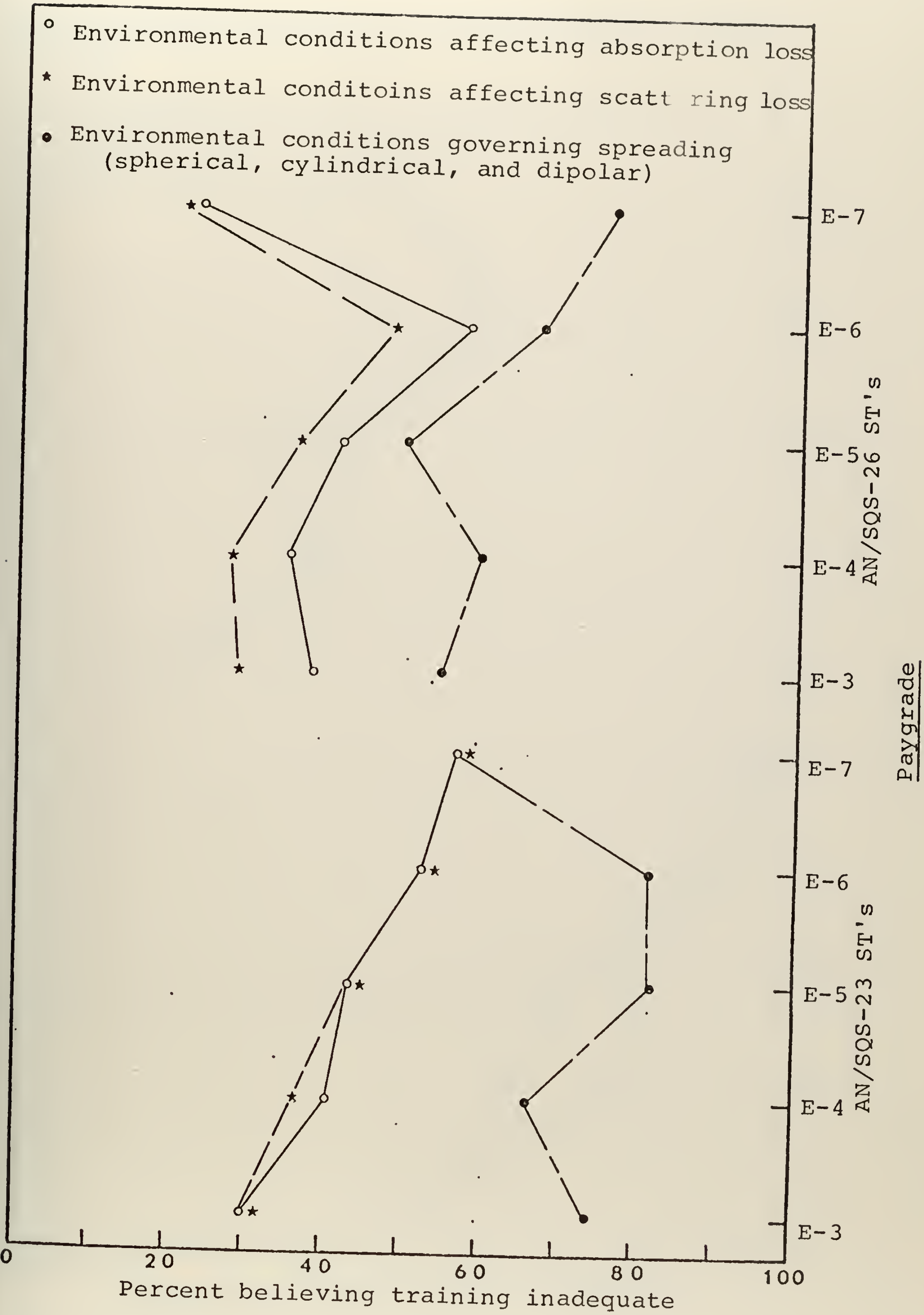

Figure 13. Relation of Inadequate Training to Subject Matter Topics, as a Function of Type Sonar and Paygrade.

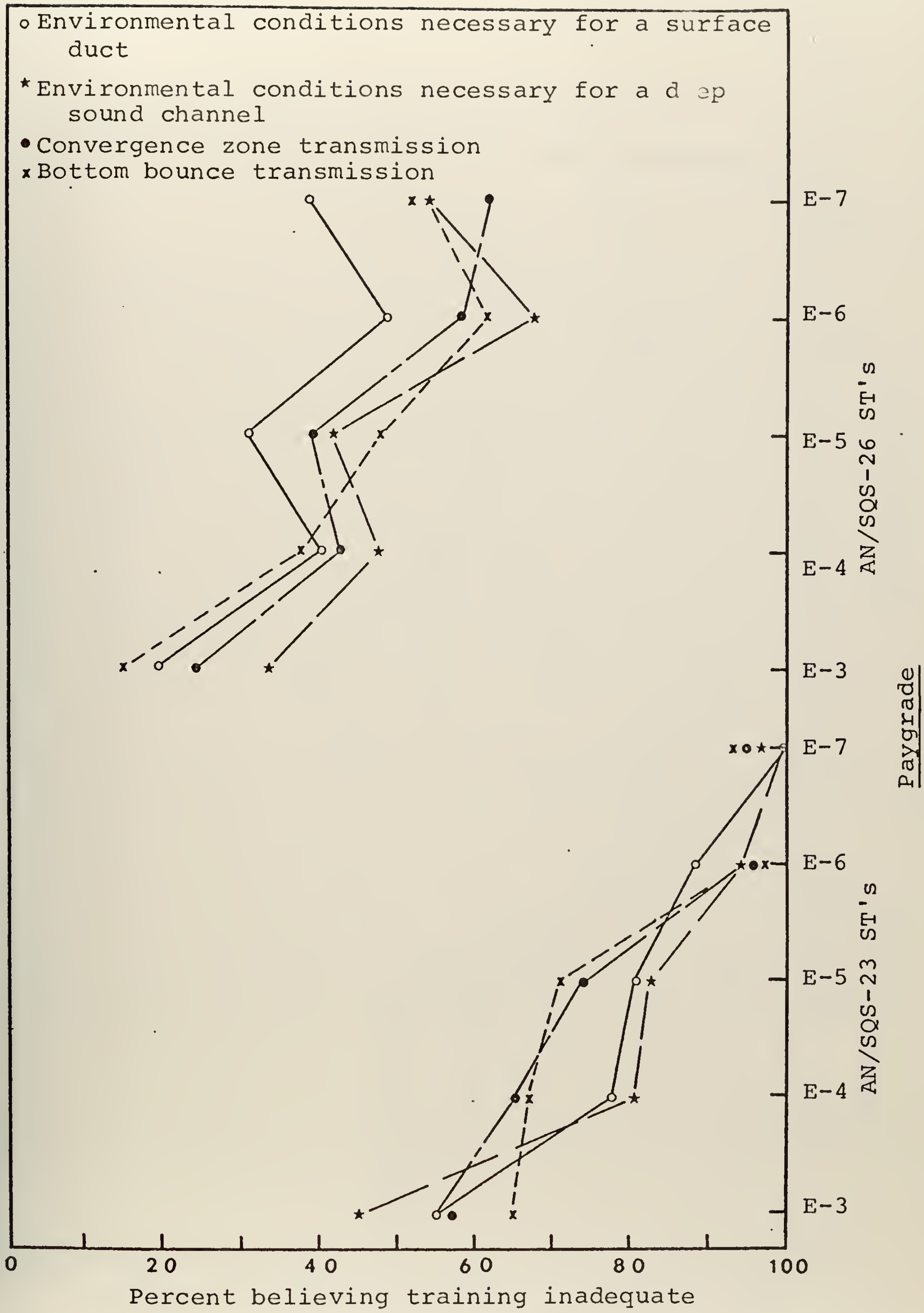

Figure 14. Relation of Inadequate Training to Subject Matter Topics, as a Function of Type Sonar and Paygrade.

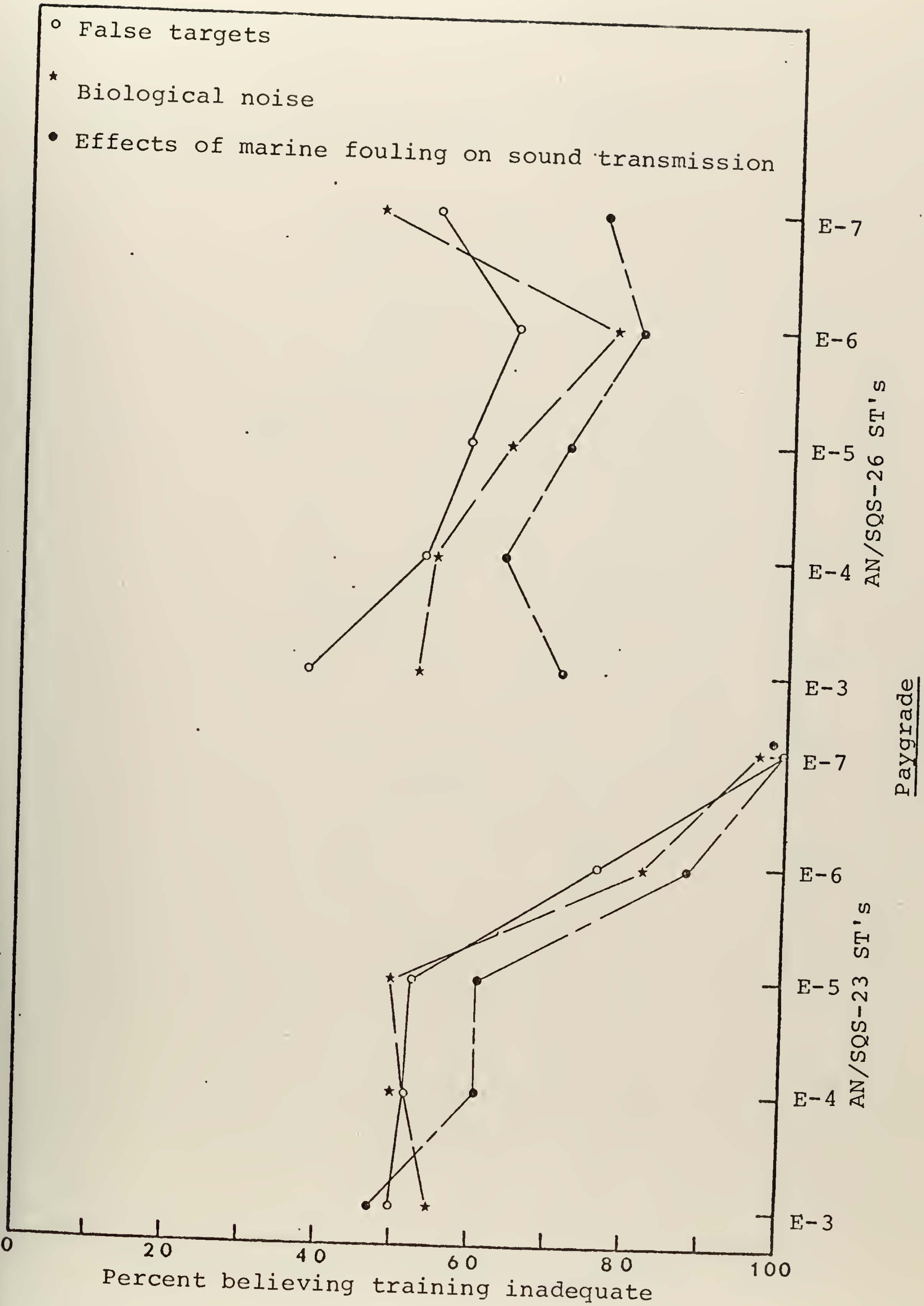

Figure 15. Relation of Inadequate Training to Subject Matter Topics, as a Function of Type Sonar and Paygrade.

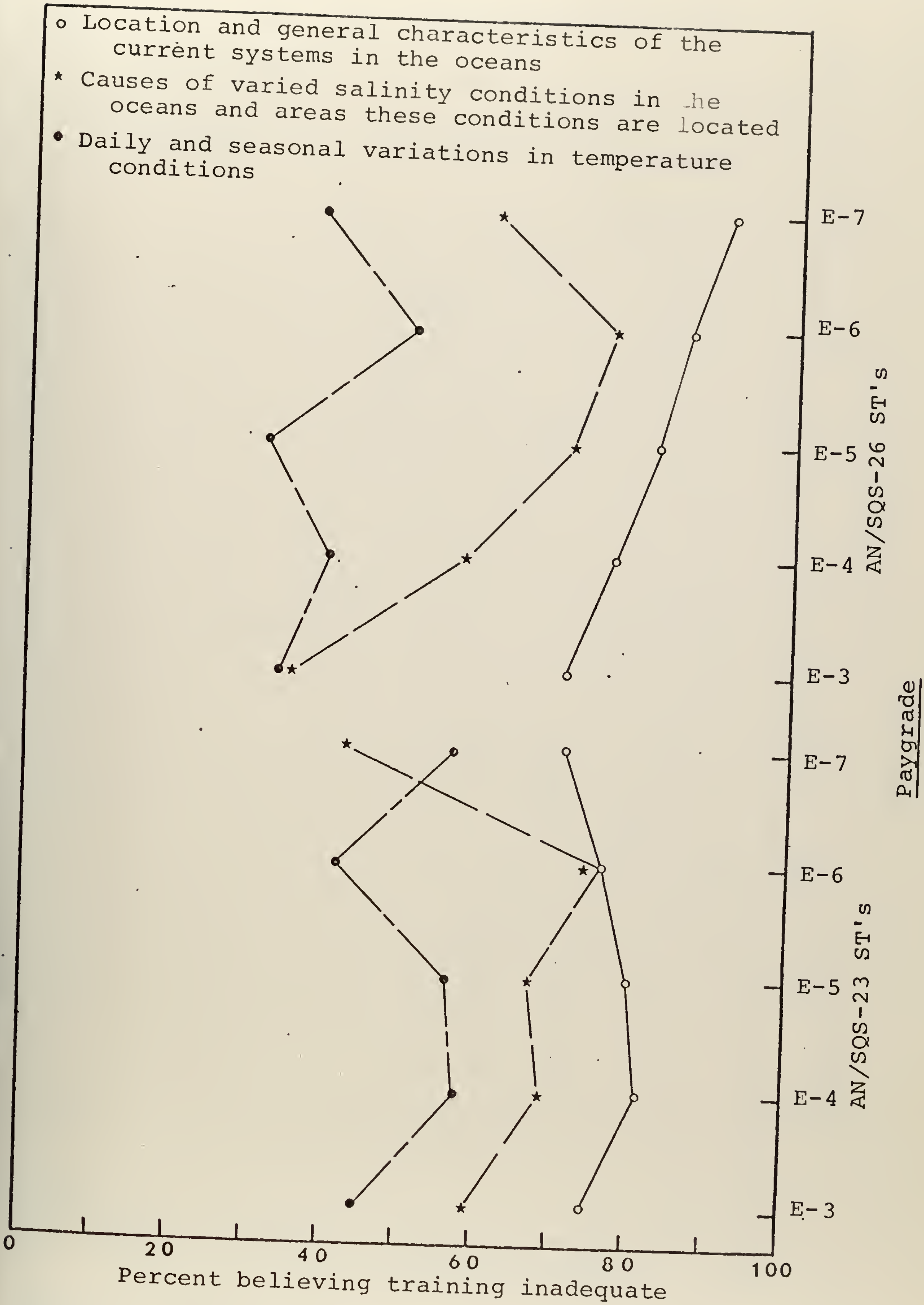

Figure 16. Relation of Inadequate Training to Subject Matter Topics, as a Function of Type Sonar and Paygrade.

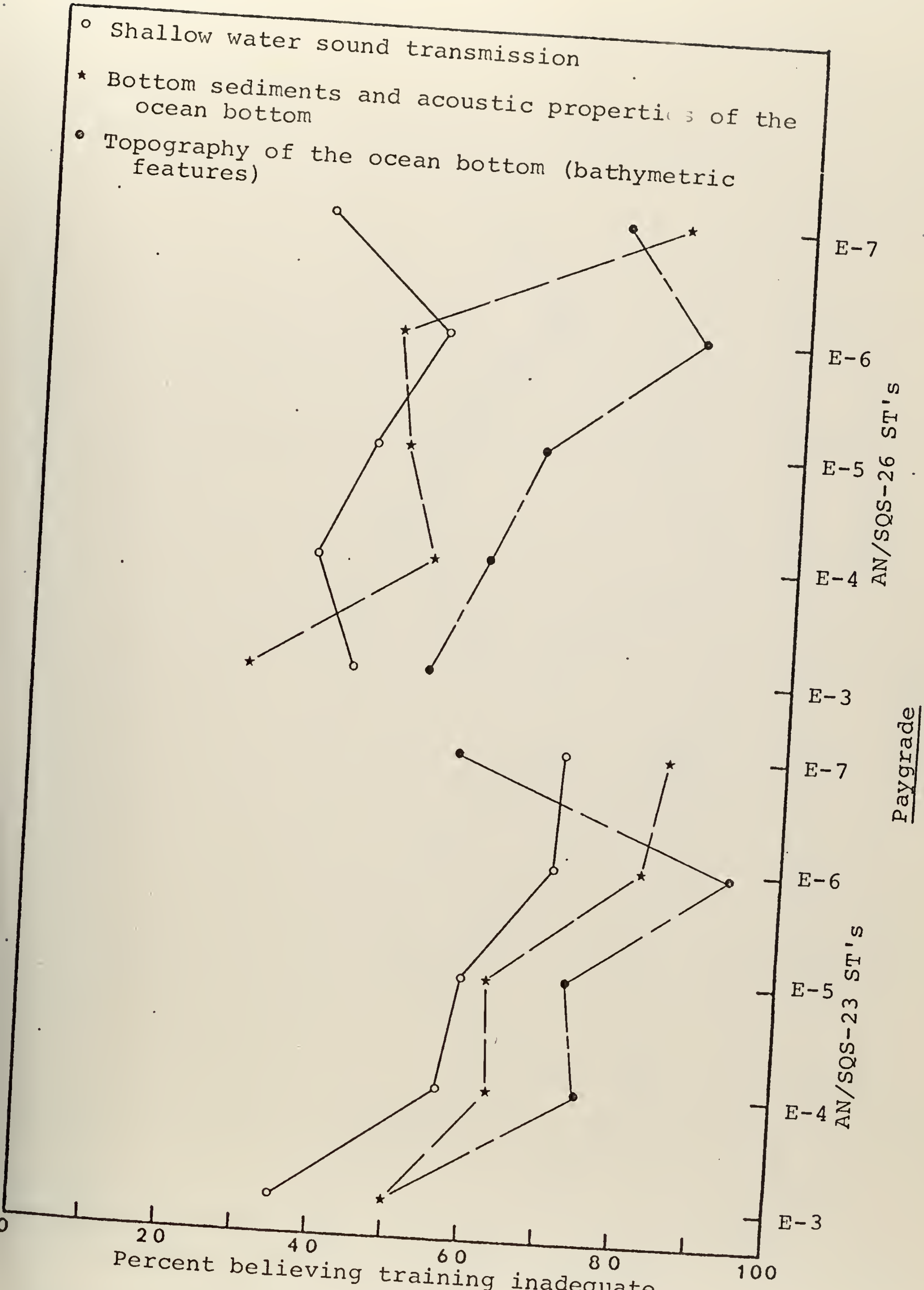

Figure 17. Relation of Inadequate Training to Subject Matter Topics, as a Function of Type Sonar and Paygrade.

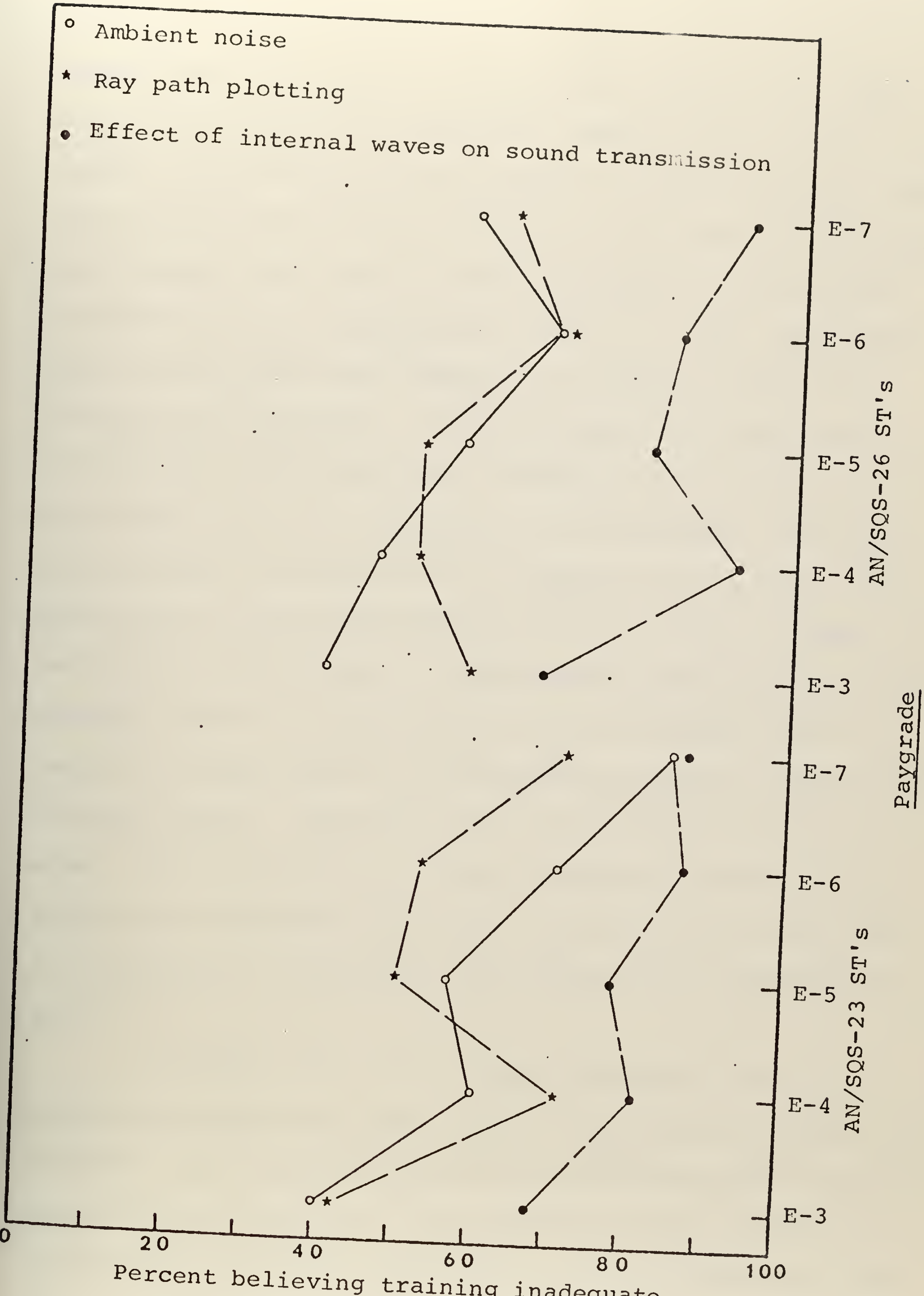

Figure 18. Relation of Inadequate Training to Subject Matter Topics, as a Function of Type Sonar and Paygrade.

technicians, 81.2%, do not believe their training was adequate in this area. The detection capabilities of sonar systems are affected by the presence of internal waves. The rising and falling of the thermocline as a result of internal waves changes the paths of signal propagation and produces variations in the transmission loss [27]. Sonar modes most affected are those which depend on acoustic transmission through the thermocline. Internal waves will affect the reverberation level where the scattering layer undergoes significant vertical translation. Low frequency acoustic fluctuation in shallow water is caused by the focusing and defocusing of sound transmitted through a field of high-amplitude internal waves. High-frequency and high-amplitude internal waves are sufficiently common in shallow water to amplify the importance of low-frequency acoustic fluctuation in mine hunting. Similarly, the entire list of subject areas can be analyzed as to the importance of each and its relation to underwater acoustics, sonar operation, and the interpretation of underwater data obtained for operational use.

A primary duty of the sonar technician rating, as presently structured, is to operate (manipulate, control, evaluate, and interpret data) sonar and oceanographic equipment for operational use. The duties and scope of the ST rating are contained in Appendix B. It is significant that such a large percentage of the fleet sonar technicians believe the training they received in the subject areas

covered by the survey was inadequate. Based on this survey, the qualification items for advancement within the ST rating listed in Appendix B, which are the minimum standards for advancement, cannot be satisfactorily attained from the training received in the Navy ST training schools. The subject topics listed are in both the area of vital (must know) and important (should know) material in order for a sonar operator or sonar watch supervisor to properly perform his duties.

Figures 3-10 show the relation of inadequate training to the subject matter topics as a function of ship type. From these eight graphs, the general level of school training of the sonar technicians surveyed can be observed and a comparison can be made between the different ship types. With the exception of four topics, the AN/SQS-26 sonar technicians believed their training was better than the AN/SQS-23 sonar technicians. This would indicate a higher level of school training in these subject areas for the AN/SQS-26 sonar technicians. In view of the subject matter content of AN/SQS-26 courses, this result was anticipated. In general, the submarine sonar technicians believed their training in these areas was more adequate than was the total destroyer sonar technicians. The minesweeper sonar technicians, represented by a small sample, have the highest overall percentages for the different ship types, even in areas such as bottom topography and shallow water sound transmission.

Figures 11-18 show the relation of inadequate training to the subject matter topics, as a function of the AN/SQS-23 and AN/SQS-26 hull-mounted sonars and paygrade. Due to the small sample size of seven men, E-8 sonar technicians were not included. The E-8 opinions are tabulated in Appendix D. From these graphs, the opinion percentage of inadequate training for each paygrade can be observed, as can the trend within each type sonar system. As previously indicated, the graphs again show the general level of school training for AN/SQS-26 sonar technicians to be higher than for the AN/SQS-23 sonar technicians.

The general overall trend for the percentage inadequacy of school training increases with paygrade from E-3 to E-6. In some subject areas, the trend continues through paygrade E-7. However, for the majority of the topics, the E-7 percentage is only approximately equal to or greater than for the E-3 paygrade. The overall difference between the AN/SQS-26 and AN/SQS-23 sonar technicians is due in part to the differences between the two sonar systems and their propagation modes. The AN/SQS-26 operator schools and maintenance schools include a number of the subject survey topics in the school curricula. The trend of the percentages increasing by paygrade is most likely due to the sonar technician's decreasing opinion of the adequacy of the training he received as experience is gained. The magnitude of the problems encountered is not recognized by the lower paygrades. The E-5 and E-6 petty officers are sonar watch

supervisors and they have the lowest opinion of the adequacy of the training received in training schools. This is a primary area of concern.

The fact that 70% of all ships selected for this voluntary survey responded and that 87.5% of the AN/SQS-26 sonar-equipped ships responded is noteworthy.

2. Ship Executive Officer Survey

This survey was made of the executive officers of ASW surface ships, submarines, and mine warfare ships. The findings show the consensus of these officers is that training received by the sonar technicians in the areas of applied oceanography is inadequate. The topics these officers feel should be included in the subject training are contained in Appendix D. They believe there is too much of an emphasis on maintenance and hardware in the sonar technician training. For the surface ASW ships, the lack of submarine services for actual shipboard training is a very significant deficiency in the training of sonar technicians. Sonar technicians should receive introductory courses, gain sea experience, and then have more advanced training provided. This sequence of study would give the STs experience to which they could relate their training. The officers believed the OT, QM, RD, TM, AX, AG, and AW ratings, in addition to other ratings used for sonar watch-standers, should receive training in applied oceanography.

3. <u>Aircraft Squadron Executive Officer Survey</u>

An opinion survey was conducted of the executive officers of randomly selected Helicopter Antisubmarine (HS), Air Antisubmarine (VS), and Patrol Squadrons (VP). The analysis of this survey is contained in Appendix D, subsection C. This survey indicated that Aerographer's Mates (AG) and Aviation Antisubmarine Warfare Operators (AW) are the primary Group IX (aviation) ratings which should receive training in oceanography. Contrary to the opinion expressed by the executive officers of ASW surface ships, the aircraft squadron executive officers, in general, consider the present training to be adequate for the needs of the ASW aviation community.

The separation of training in the AW "pipeline" allows the students to develop the required association of environmental effects on the various ASW sensors. Class A school presents the academics of oceanography, and the Fleet Aviation Specialized Operation Training Groups (FASOTRAGRU's) and readiness squadrons instruct in practical and tactical application during the equipment operation data analysis phase. The oceanography training program, as considered at the time of the survey, was not instituted until 1969. Hence, many aircrewmen have not received this training.

Basically, the Air Antisubmarine Squadrons were satisfied with the oceanography training program as existed at the time of the survey. The oceanographic training program was adequate for the S-2E/G ASW sensor operators.

More information on practical application and real time analysis of bathythermograph information was considered to be necessary for P-3 and S-3A aircraft sensor operators. The relationship between environmental effects and ASW cannot be overstressed to the P-3C and S-3A aircrewmembers. The Helicopter Antisubmarine Squadrons surveyed indicate more training in oceanography is in order for their aircrewmen than was being provided by Class A AW school and the FASOTRAGRU's. The majority of the topics compiled in Appendix D, sub-section C, as requiring inclusion in a formal training program were submitted by HS squadrons. The VP community believe the problem of training AW's has been recognized and is being resolved.

The major problem is in the area of refresher training on a scheduled basis, preferably annually, to augment, update, or even repeat with emphasis the previous training in oceanography. At the present time a great amount of oceanographic material is initially presented to the AW, in a relatively short period of time, with no continuing program to augment this training. This is where the need is in AW training. Additionally, the training should be provided by trained officer oceanographers with an aviation ASW background and not by enlisted personnel where background in oceanography is fleet experience only.

The squadrons surveyed had much praise for the FASOTRAGRU courses in oceanography. However, since the survey was conducted, FASOTRAGRUPAC has ceased to conduct

the <u>Basic Oceanography for Aviation Antisubmarine Warfare Operator</u> (AW) course. The last class conven d in May 1972. FASOTRAGRULANT will cease conducting their basic enlisted oceanography course in the near future. The disestablishment of these courses was apparently done as an efficiency measure. Class A AW school located at the Naval Air Technical Training Center, Memphis, Tennessee, will take over the oceanography training for AW's going to both fleets. As discussed in Section III, the AW school curriculum is undergoing revision. The revised course will include a 40-hour oceanography unit. The impact of this change in the training of AW's will not be known for some time and will bear close observation. FASOTRAGRUPAC may continue to teach oceanography, but as a part of another course syllabus.

B. RECOMMENDATIONS

Based on the findings presented in this section, the comments contained in Appendix D, and personal research, the following recommendations are made concerning the AW and ST training. The ST rating recommendations are made for the present rating structure.

1. Actual shipboard training with a target submarine, in a realistic ASW situation, is recommended for both an at-sea phase in ST Class A-1 and operator training schools, and for further shipboard training after school completion. The ashore simulators, such as the 14E19 training device, are

good training tools, but they do not provide the training needed to cope with the actual ocean environment.

2. Prospective sonar technicians should be assigned to sea duty for about 6-12 months immediately upon completion of recruit training in order to gain sea experience with qualified sonar technicians. It is recommended that after the at-sea tour, the prospective STs be assigned to the training schools on a <u>returnable</u> quota basis only. This would help to eliminate personnel who were incorrectly classified at the recruit training command. The school trainee would then have at sea experience to relate his training to, and could build a deeper and longer lasting knowledge of the subject matter. Shipboard leading petty officers would also have the opportunity to provide the prospective ST with his initial sonar training knowing the ST would return to his sonar crew after completion of training schools. This recommendation should be considered only on a returnable quota basis.

3. A Class C school course in applied oceanography, similar to the AG Class C Air-Ocean Environment School, is recommended for paygrade E-5 and above sonar technicians to provide sonar watch supervisors with additional environmental training.

4. The development of programmed instructional material on the subject of oceanography as applied to underwater acoustics and sensor operation is recommended. The programmed material should be divided into two parts, basic and advanced,

upon which the sensor operators could build their knowledge.

5. An increased emphasis on underwater sound propagations, and the effects of the environment is recommended for Class A-1 ST schools.

6. An expansion of classification schools with mandatory attendance requirements at regular intervals as a refresher/update for STs is recommended.

7. The instruction at Class A schools, classification schools, and other schools dealing with underwater acoustics and environmental effects should be given by an officer oceanographer with fleet experience in order to relate ASW and mine warfare operations to the environmental effects of the ocean medium.

8. The fact that a trainee is an excellent student is of no consequence unless he can demonstrate that there is a strong relationship between performance as a student and ultimate on-the-job performance. Very few ST trainees are disenrolled from Class A school for academic reasons, which indicates training is being given to pass tests and not for required performance. If mediocre work is all that is required as in a no-fail situation, then the fleet will receive mediocre, insufficiently trained STs. It is recommended that ST schools teach for end performance and not just test passing. A study of AW performance in various training pipelines has been made [28]. A similar study for the ST rating is recommended.

9. Additional instruction in surface ASW ST courses on the subjects of passive sonar, and the use, interpretation, effectiveness, and reliability of SHARPS is recommended.

10. It is recommended that a correspondence course, for both officer and enlisted man, be redeveloped that relates applied oceanography to antisubmarine warfare.

11. Until such time as a correspondence course is available, it is recommended that enlisted personnel be encouraged to enroll in off-duty educational programs such as PACE, USAFI, and Tuition Aid.

12. It is recommended that a refresher course be provided on at least an annual basis to update, reinforce, and augment the oceanography knowledge of the AW.

13. It is recommended that the FASOTRAGRUs continue to provide the basic AW oceanography courses as was previously done. The Class A trainees may be receiving more hours of oceanography training, but at that stage of their training development they have little or no idea how or where the training in oceanography will be used. The oceanography training can be tied to their job requirements when the instruction is presented at the FASOTRAGRUs.

14. Greater personnel stability coupled with intensive training is required to maintain the necessary level of proficiency in ASW. ASW personnel have to work closely as a team and general personnel turbulence destroys the team.

15. Better quality control and performance monitoring of instructors is recommended.

16. Standardization of curricula format between COMTRAPAC, COMTRALANT, Naval Technical Training, and other training commands is recommended.

17. There is a myriad of publications on the topics of sonar range prediction, oceanography and underwater sound, and environmental effects on ASW. The distribution lists of the publications vary considerably, and some publications have no printed distribution list which prevents determination of the holders of the publications. The information contained in the publications should be consolidated for the use of enlisted personnel or a reference publication distributed which gives information on where the information is available and how to use it.

VI. RECOMMENDED TRAINING, EDUCATION, AND ADVANCEMENT PROGRAMS INVOLVING OCEANOGRAPHY

The programs recommended in this section are considered to be the optimum for enlisted personnel. They are designed to increase the basic oceanography knowledge of all enlisted personnel and advance the knowledge of specific ratings to that required for expertise in their specific occupational areas.

The recommendations are made with the full realization that an increase in training school material in one subject area usually necessitates a decrease in another area. Knowledge of the environment must be included in subject areas of vital and should-know information. Compensation should come from areas of nice-to-know training material or training school lengths should be increased.

As emphasized before in this study, the oceans provide the environment in which naval forces must live and operate. To perform satisfactorily in this environment, we must understand it. The basic knowledge must be present at all levels of responsibility, from the recruit through the officer ranks.

The most recent Operational Oceanographic Support Services Conference was held 10-13 April 1972 in Monterey, California. The purpose of the conference was to review the products generated by the Naval Weather Service Command to support the oceanographic needs of the fleet [20]. A competent

group of attendees, both military and civilian, considered the agenda item, "Training and Education." The discussion of this topic, as presented in the conference report is quoted below:

> Extended contact with personnel indicates a lack of basic knowledge concerning the environmental process. This is true at all levels of responsibility and includes meteorological and oceanographic education. This is the prime cause for misuse or misapplication of environmental services and support. The most carefully prepared forecast can be rendered useless by a consumer who is not aware of what it means in terms of his units' effectiveness. An increased awareness of the environment and its processes is necessary for all who come in contact with it in day to day operational situations. The environmental community would do well to investigate present levels and content of training now available to nonenvironmental types. This would include training at the fleet level formal schools and correspondence courses, all of which provide involvement in training nonenvironmental oriented personnel who require some degree of environmental knowledge.

Since this paper is confined to enlisted training and education, only the above recommendations pertaining to enlisted personnel will be discussed. Development of a correspondence course on the subject of the air-ocean environment was proposed. Also, a recommendation to give a basic course in the Class A or B schools to seamen, radiomen, radarmen, etc., on the environmental effects on sound or electromagnetic propagation, as applicable, was made. The action of the Commander Naval Weather Service was to disapprove both recommendations. The correspondence course proposal was disapproved because, "Information is already available in existing correspondence courses; e.g., _Aerographer's Mate 3 & 2_, _Introduction to Sonar_, _General Oceanography_, etc." The subject information is not available in

AG 3 & 2; the Introduction to Sonar correspondence course is not adequate to meet the requirement for study of the air-ocean environment; and General Oceanography is an overview of, and an introduction to, the multifaceted field of oceanography, which contains three simple questions on sound in the ocean. The other correspondence course on this subject, Oceanography in Antisubmarine Warfare, has been declared obsolete and cancelled. The recommendation to include environmental effects in schools was disapproved because, "Training in the 'basics' of the Air-Ocean Environment is included in most A and B schools as well as many C schools." As a result of this thesis work, it was determined that there is no information on environmental effects taught in Class A Radarman School, and only one lesson is included in the advanced Operations Specialist Course. Quartermasters receive no training on this subject in school. Sonar technicians (ST) receive the basics of the theory of underwater acoustics, and the aviation antisubmarine warfare operators (AW) receive about 40 hours of oceanography in Class A school. Besides the AWs, only the Class A and Class B Aerographer's Mate Schools and Class C Air-Ocean Environment Course contain adequate information on environmental effects and the air-ocean environment. Only AGs are eligible to attend these schools. The implications derived from the agenda item, discussion, recommendations, and action taken are twofold:

1) The general level of knowledge of the ocean environment is inadequate among fleet personnel.

2) The action taken by Commander Naval Weather Service indicates a lack of interest in increasing the basic knowledge level of fleet personnel on this subject.

To develop an increased awareness in the environment, environmental effects, and oceanography, training must start with the recruit.

A. RECRUIT TRAINING

As RADM E. C. Stephan stated ten years ago, an awareness, an interest, and curiosity in oceanography must be fostered in an enlisted man entering the navy [1]. At the present time, there is no oceanography-oriented training included in the recruit training program. It is essential that all recruits be given an introduction to basic oceanography as a part of recruit training to create interest in the ocean environment where they will live and work while serving in the navy.

There are two excellent sources of information already available for use in instruction in basic oceanography. The material presented in both of the following sources is in language which is understandable at the secondary school level.

Questions About the Oceans [29] was published by the U.S. Naval Hydrographic Office to provide answers to the most frequently asked questions on oceanography and the marine sciences. The book provides a suitable introduction to selected marine subjects, with specific references to

additional information. This is the most important contribution of the book.

The National Oceanographic Data Center (NODC) has prepared An Oceanographic Curriculum for High Schools [30], which contains 18 suggested one-hour lectures. All of the lectures are at the appropriate level for recruit training. Each lecture contains references to material for further reading and suggested films. The lectures include material on the subject of pollution, which is vital for all navy personnel. The appendixes include sources of materials, charts, films, and additional information. With very few modifications, the curriculum is adaptable for recruit training. The information could also be prepared in the form of a programmed text for use in individual recruit training. The inclusion of an oceanography phase in the recruit training curriculum, might assist in recruiting service promotions.

B. GENERAL MILITARY TRAINING

The navy has a stated policy of actively participating in a program to protect and enhance the quality of the environment. However, the rate training manuals, Basic Military Requirements, Military Requirements for Petty Officer 3 & 2, and Petty Officer 1 & C contain no information on pollution control. The recently published rate training manual, Military Requirements for Senior and Master Chief Petty Officer, has a short, concise chapter on this topic. The

military qualifications for advancement presented in Appendix B lists environmental pollution control as a standard for advancement to pay-grade E-2. Information on environmental pollution control should be included in the three rate training manuals which do not currently include this subject matter.

The Military Requirements for Petty Officer 1 & C manual contains two pages on the topic of the Navy in Marine Research. This is minimal information. The Navy Ocean Science Program contributes to the primary mission of national defense and also makes sizable contributions both to general oceanographic knowledge and to the attainment of other national marine science program goals. Additional benefits include contributions to broad, scientific, economic, and political objectives in furtherance and protection of U.S. maritime interests [31]. A military qualification for advancement, on the subject of the Navy Ocean Science Program, should be added under the general subject of SEA POWER as a requirement for advancement to at least the E-3 level. As the former Secretary of the Navy, Paul Ignatius has stated, "To many, the term Sea Power defines the act of controlling the world's sea lanes through the employment of combatant ships. In reality, Sea Power has a broader definition. It encompasses the Merchant Marine, oceanography, ocean engineering, marine research and technology as well as naval power" [44].

Ships and shore activities should emphasize the importance of the oceans to national security, the environmental aspects of the oceans, and the importance of oceanography to naval operations. This could be accomplished through the use of films, plan-of-the-day notes, and other available means of communication.

C. OCCUPATIONAL TRAINING

Recommendations pertaining to specific ratings will be presented in this section.

1. Radarman

The shipboard executive officer survey, described in Section V and Appendix D, identified the radarman (RD) rating as requiring training in oceanography. As previously stated, there is no instruction on environmental effects included in the Class A Radarman School, and only one lesson is included in advanced Operations Specialist Course. Radarmen are directly concerned with electromagnetic radiation over the ocean surface and sea state scattering effects on the radiation.

In ASW, contact evaluation and classification should occur at two levels aboard ship; the sonar control level and the command (CIC) level [32]. The command level function requires the correlation of sonar information from other sensors. This function is external to sonar and should be performed in CIC. Because of this, radarmen must have a knowledge of the effects of the environment on sensors, tactics, and the employment of forces. Radarmen must have

a thorough knowledge of long range propagation modes in order to recommend the proper search patterns. For AN/SQS-26 equipped ships, it is suggested that the bottom bounce charts be displayed in CIC [33]. The AN/SQS-26 operating doctrine concept is shown in Figure 19 and clearly displays the relationship of the sonar supervisor to the command (CIC) level. CIC personnel must have a knowledge of the environmental effects to assist at the command level.

The addition of a phase on the topic of underwater sound propagation and environmental effects is recommended for the Class A Radarman School curriculum. The curriculum of the advanced Operations Specialist Course should be expanded to include decision making or recommendations based on the composite picture of environmental effects, tactics, and employment of forces.

2. Quartermaster

The quartermaster (QM) rating was also identified in the shipboard executive officer survey as requiring training in oceanography. The QM qualifications for advancement include the effects of currents and weather on ship navigation. Senior QM petty officers are often involved in the operational planning of exercises involving ASW and mine warfare units. These QM's should have a basic knowledge of the environmental effects on underwater sound propagation. A thorough knowledge of the ocean current systems should be attained by all QMs. For the QMs attached to ships equipped with long-range mode sonars, they must be familiar with

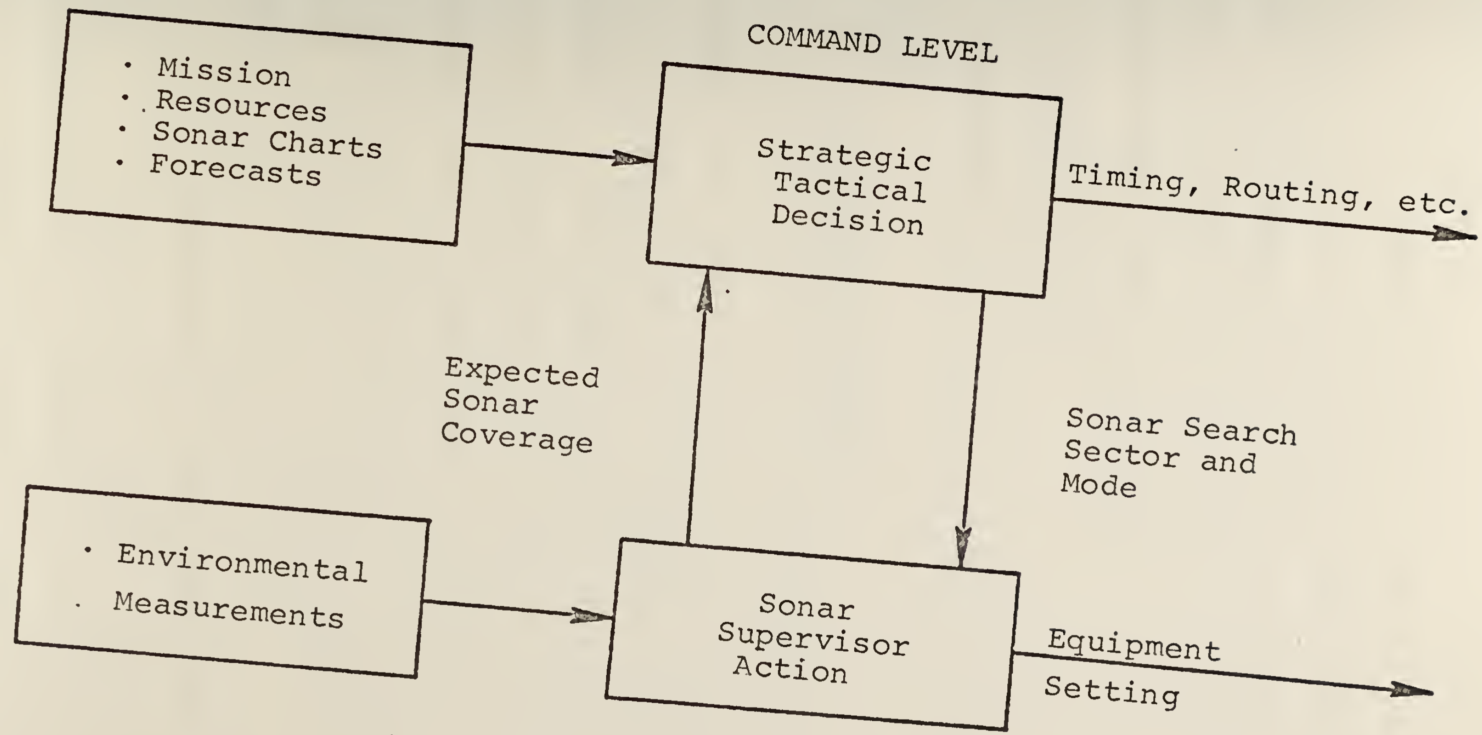

Figure 19. Operating Doctrine Concept [33].

bottom bounce and convergence zone areas, high ambient noise areas, and areas where environmental effects seriously affect sound propagation.

It is proposed that a unit of instruction on the topics of basic oceanography, sonar long-range propagation modes, environmental effects on underwater sound transmission, and acoustical forecasting be added to the basic Quartermaster school curricula.

D. PROPOSED RATINGS

Recommendations for two proposed ratings are made in this section.

1. ASW Sensor Operator

Training for sonar maintenance historically has received far greater attention than training for sonar operation as measured by the investments in training time and equipment. The reason for the difference in emphasis seems to be that development of a training course for sonar maintenance is a straightforward consequence of the physical and electronic characteristics of the hardware, whereas the method for developing a training course in operating techniques is by no means obvious [5].

The increasingly more complicated sonar and underwater fire control systems that require operation, maintenance, and repair by sonar personnel have resulted in many Navy Enlisted Classification (NEC) codes becoming a part of the ST rating. A number of these NECs are listed in Appendix C. Currently, there are 24 surface ASW sonar technician, six

submarine sonar technician, and two mine warfare technician NEC codes. This is an unwieldly group of NECs.

The findings of the sonar technician survey discussed in Section V and Appendix D indicated a lack of training in the environmental effects of the ocean on underwater acoustics. Numerous comments were also made by both the sonar technicians and by the shipboard executive officers concerning the inadequacy of maintenance training. The training which the sonar technicians are receiving is inadequate in depth resulting in a sonar school graduate with a bare working knowledge of his rate. In other words, the ST trainee is receiving a substantial amount of training in a short period of time and then is passed to the fleet as a trained technician.

Sonar systems and ASW weapon systems have undergone major changes in recent years and will most likely continue to undergo other major changes. Acoustic warfare has barely begun to touch the majority of operators. The gain that can be achieved by taking advantage of the characteristics of the sea in the placement and operation of hydrophones and transducers is more than the electronics man can obtain [11]. With the AN/SQS-26 sonar system, the AN/SQS-35 sonar system, and the deep towed passive arrays of the near future, it is very apparent that the surface ASW forces have a requirement for skilled sensor operators. These systems all have a dependence upon environmental factors for mode selection and depth positioning. Under current doctrine, the sonar watch

supervisor of the AN/SQS-26 system is required to recommend the sonar search mode, based on environmental conditions, to the Officer-of-the-Deck. The sonar watch supervisor must thoroughly understand the environment and the effect on propagation paths in order to make the recommendation [33].

The formal training currently provided to the prospective ASW officers is inadequate. It is comprehensive in scope, but can hardly be regarded as adequate in depth. Additionally, the prerequisite of sea experience on destroyer-type ships is not met by the majority of the officers. ASW officers are unprepared to assess the performance capabilities of sonar technicians, short of the rather loose observation that it appears that they have the system operation satisfactorily [5]. The above described ASW officer situation has existed for several years in surface ASW ships.

A great deal of time and money has been directed to the development of new transmission modes, signal processing techniques, and data display methods in an attempt to enhance overall detection capability. Correspondingly little effort has been devoted to training sonar operators in operating techniques to maximize detection probability. Training in operating techniques has not been effectively accomplished in the schools, and at sea operations have not afforded reasonably frequent opportunities for practice to maintain detection skills [5].

Thus, the Navy is faced with a situation of having inexperienced, under-trained ASW officers and sonar technicians

who are not adequately trained in operations or maintenance. The best remedy for this unsatisfactory situation is to assign the sonar technician to maintenance duties only and establish a new rating for ASW sensor operators. The ASW sensor operator should be thoroughly trained in operating techniques and their relation to the environment. As previously stated, the ST survey has shown that sonar technicians do not believe they have been adequately trained in the environmental effects on underwater acoustics. The practical and knowledge factors listed in Appendix B for sonar technicians would be applicable to an ASW sensor operator rating. The ASW sensor operator should not be encumbered with maintenance responsibilities except planned/ preventive maintenance. The ASW sensor operator could then become skilled in the varied aspects of ASW operations. The primary duty of the ASW sensor operator rating would be to operate and adjust antisubmarine warfare systems and equipment, interpret, classify, and apply data obtained from ASW sensors. The formation of an ASW sensor operator rating would greatly alleviate the current problem of inexperienced, poorly trained ASW officers and, additionally, would serve to increase the performance of sonar technician maintenance personnel.

The Aviation Antisubmarine Warfare Operator (AW) rating was established in 1968 and, after some initial problems, has developed into an extremely knowledgeable group of aviation ASW sensor operators who are dedicated to ASW

operations without spending their time on sensor equipment maintenance and repair. A separate warrant officer and limited duty officer designator was established for AWs to prevent promoting the best sensor operators out of the program. The ASW community feels that it takes a period of several years before an AW becomes a completely effective sensor operator. After extensive training in the acquisition of skills in connection with the operation of ASW sensor equipment, those men would be lost or improperly utilized, if advanced to WO or LDO categories which were not related to AW functions [34].

A career pattern could readily be developed through the warrant officer and limited duty officer ranks to develop career ASW specialists. These officers could then serve as shipboard ASW officers, on ASW staffs, and in ASW training school billets. A policy of closed-loop detailing should be employed to keep these specialists in either operational or training billets.

A typical career pattern for the ASW sensor operator is shown in Figure 20. This career pattern provides career ASW specialists. The recruit training graduate with an initial four year enlistment would proceed directly to the fleet for 6-12 months to gain sea experience as a sensor operator trainee. During this period of time, the improperly classified trainees and the undesirable trainees would be eliminated from the program. At the end of the sea experience tour, the ASW sensor operator trainees would be transferred

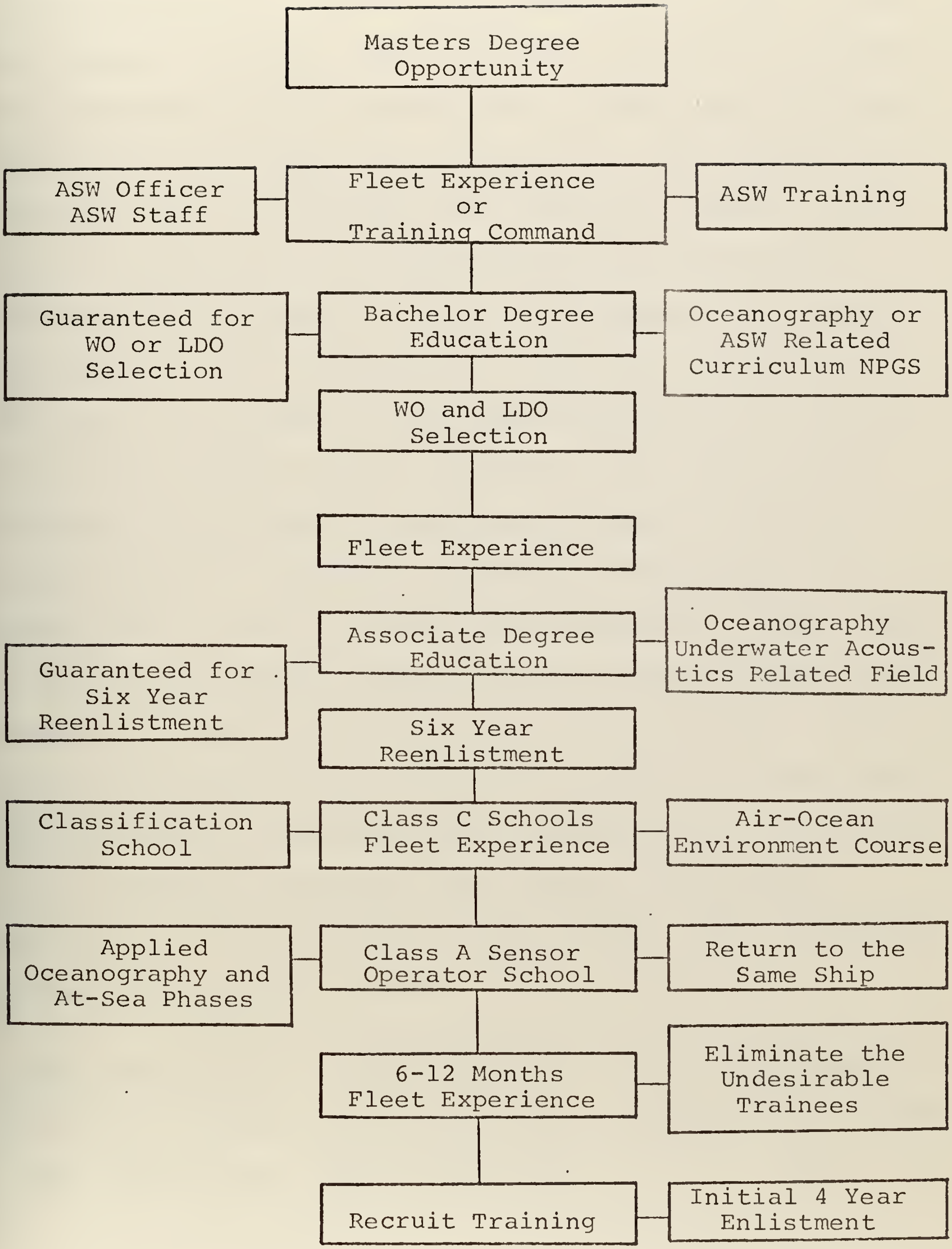

Figure 20. Career Pattern for ASW Sensor Operator Rating.

to Class A sensor operator school for training including a curriculum phase on applied oceanography and a phase of at-sea operator training. Upon graduation from Class A school, the ASW sensor operator would return to the same ship where his initial fleet experience was gained. While serving the remaining term of enlistment, the ASW sensor operator would have the opportunity to attend Class C and fleet schools, including classification courses and the Class C Air-Ocean Environment school recommended in Section V. At the end of the initial enlistment, a guaranteed opportunity to obtain an associate degree would be tendered as an incentive for a six-year reenlistment. The associate degree course of study would be in underwater acoustics, oceanography, or other field related to the ASW sensor operator rating. After obtaining an associate degree, the ASW sensor operator would serve in the fleet to gain further fleet experience. Prior to the completion of the ten years of service, the ASW sensor operator would be guaranteed the opportunity for a bachelors level education, contingent upon selection for warrant officer (WO) or limited duty officer (LDO). The recommended WO or LDO categories follow:

ENLISTED RATING	WO CATEGORY	LDO CATEGORY
ASW Sensor Operator	ASW operations	Antisubmarine Warfare
Sonar Technician	Sonar Technician	Sonar

The current paths of ST advancement to either operations or electronics, which result in a loss of ASW expertise, would be cancelled by this recommended program. The bachelors level education would be provided at the Naval Postgraduate School with a major available in oceanography or other ASW related science. The Bachelor of Science in oceanography major would enhance the WO and LDO education level and broaden their educational experience on the environmental relationships to sensor operations and overall ASW operations. Upon graduation from the Naval Postgraduate School, the WO or LDO would be assigned to the fleet as ASW officers, to ASW staffs, or to ASW training commands. The top performers would be given the opportunity to attain masters degrees in their field.

The advantages of this ASW sensor operator career pattern are that:

a. It provides an ASW officer who is an ASW career specialist skilled in the operations of ASW sensors.

b. It provides an ASW career specialist for instructor duty in ASW training schools, both officer and enlisted.

c. It provides ASW career specialists for billets on ASW staffs.

d. Fleet operators would be able to call upon the experience of career ASW officers.

e. It would relieve senior petty officers from being junior administrators, with little <u>recent</u> experience, as is

the situation with ASW officers who are inadequately trained in operations.

The recommended career pattern is readily adaptable to other ratings and could be utilized in recruiting efforts.

2. Oceanographer

In 1961, a requirement for a study to be undertaken by the Bureau of Naval Personnel for the purpose of determining the need for an enlisted rating of Oceanographic Technician was made by the Chief of Naval Operations. The requirement was based upon recognition that a shortage of knowledgeable manpower in oceanographic disciplines existed and that positive action was required [15]. As previously stated in Section I, in 1964 it was not considered sufficient that all education and training in oceanography be concentrated at the officer level. At that time, the Aerographer's Mate rating was considered the logical one to take on the additional responsibilities of oceanography training. It was believed that the field of oceanography had reached a level of importance and application at which serious consideration should be given to formation of a corps of enlisted men trained in oceanography so that their skills would become available to most fleet units rather than the larger ones. "The additional training in oceanography will produce a highly skilled and valuable man who can make a most useful contribution to the success of naval operation" [4]. Hence, both of the environmental sciences were combined into one rating.

The fields of oceanography and meteorology are too complex and involved for one individual to develop the expertise required to properly perform his assigned duties in both fields in a professional manner. A review of the scope of the Aerographer's Mate rating, which is contained in Appendix B, reveals the following duties which are oceanography oriented.

a. Observe, collect, record, and analyze oceanographic data.

b. Interpret oceanographic codes and enter data on appropriate charts.

c. Operate ancillary computer equipment for the processing, dissemination and display of environmental data.

d. Perform preventive maintenance on oceanographic equipment.

e. Prepare warnings of severe and hazardous sea conditions.

f. Forecast oceanographic conditions.

g. Prepare and present briefings concerning current and predicted environmental conditions and their effect on operations.

The Aerographer's Mate qualifications for advancement which are pertinent to oceanography are listed in Appendix B.

Based on the foregoing duties and qualifications, a new general rating of Oceanographer is proposed. A career pattern, similar to that outlined for the proposed ASW

sensor operator, would produce a career specialist in oceanography. The WO and LDO categories would be Oceanographer and Oceanography, respectively. There is a current need for this rating on ASW ships, particularly AN/SQS-26 ships. The success or failure of ASW operations depends largely on the ability of the unit commander or shipboard commanding officers to take advantage of the environment. The most frequent item mentioned in the ST survey was the lack of training in the use, interpretation, effectiveness, and reliability of SHARPS data. An enlisted oceanographer would have the background and experience to use the environmental data properly.

SHARPS (Ship, Helicopter Acoustic Range Prediction System) provides computer generated range predictions for sonar systems at various ship speeds and operating modes. Most of the environmental data is extracted from Fleet Numerical Weather Central analysis and prognosis fields [35]. The SHARPS predictions for the acoustical domain in which the user ship is operating does not have the required accuracy. It is essential to use on-the-spot environmental measurements and conversion manuals or shipboard computers [36]. Simply stated, real time information is required to determine propagation modes based on the in-situ environmental measurements. In a hostile submarine environment, the is not sufficient time to obtain a SHARPS forecast from shore. To have the accuracy required, it must be done aboard ship. Through the use of a shipboard forecasting

system, including a sound ray path analyzer, the enlisted oceanographer can determine the instant and constantly adjustable prediction of sound ray paths for prediction of the optimum mode for fixed transducer operation and optimum variable depth sonar transducer depth. The enlisted oceanographer would be a valuable assistant in predicting the acoustic conditions for mine hunting.

A skilled enlisted oceanographer assigned to non-ASW ships would greatly benefit the Navy Ocean Science Program by obtaining bathythermograph information, sea condition observations, and measurement of other oceanographic parameters provided the required equipment was available on board each ship.

A skilled senior enlisted oceanographer should be assigned to destroyer flotilla and squadron staffs to assist in operational planning and to provide the oceanography experience and training required for the staff functions. This would assist in filling the void left due to the reluctance of commands to P-code officer billets for oceanography [10].

In addition to ASW and minewarfare duties, enlisted oceanographers would be available for assignment to oceanographic forecasting duties to include sea ice forecasting, sea and swell forecasting, sea surface temperature and mixed layer depth forecasting, and surf forecasting. The proposed Oceanographer rating would forecast, measure, and interpret the environmental conditions of the oceans as opposed to the

Aerographer's Mate forecasting, observing, and interpreting the atmosphere conditions.

E. PRIORITIES FOR IMPLEMENTATION OF THE RECOMMENDED PROGRAMS

In view of the ever present lack of funds, an order of priority for implementation of the recommended program is necessary. The most urgent problem facing naval operations is in the area of antisubmarine warfare. The lack of training both at sea and in schools should receive the immediate attention if there is to be a strong ASW force. The first priority is to establish an ASW sensor operator rating and assign sonar technicians to maintenance duties. The remaining order of priority follows.

1. Provide training in applied oceanography for radarmen.

2. Establish the proposed oceanographer rating.

3. Implement a phase of recruit training on the topic of basic oceanography.

4. Change the Basic Quartermaster Course curricula to include a unit on applied oceanography.

5. Add information to the Military Requirement rate training manuals on the subjects of pollution and the Navy Ocean Science Program.

VII. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. The study of the rate training manuals, training school courses, and other information clearly indicates that the primary reason, at the present time, for obtaining a knowledge of the oceans and of the processes involved is the support of ASW operations. The longer ranges of modern sonars and weapon systems have greatly increased the effects of the environment on these systems. The understanding of the ocean medium, gained through oceanography, must continue to be exploited if ASW operations are to be successfully conducted. The breadth of the ASW environmental requirements is of such magnitude that the majority of the requirements for other types of naval operations are included.

2. The increasingly complex sonar and underwater fire control systems that require operation, maintenance, and repair, under the supervision of ASW officers who are presently marginally trained, indicates the need for an additional enlisted rating to operate ASW systems and to interpret, classify, and apply data obtained from ASW sensors.

3. The sciences of oceanography and meteorology are too complex and involved for an individual to develop the expertise required to properly perform duties in both. The Aerographer's Mate should be assigned duties relating to

forecasting, observing, and interpreting the environmental conditions in the atmosphere. A rating specifically assigned to forecasting, measuring, and interpreting the environmental conditions of the ocean is required.

4. The aviation antisubmarine warfare community is more advanced than the surface antisubmarine warfare community in the ability to utilize knowledge of the oceans to their advantage in ASW.

5. The present training in applied oceanography is adequate to meet the needs of the ASW aviation community.

6. Aerographer's Mate is the only rating currently receiving thorough training in oceanography. Aviation Antisubmarine Warfare Operators receive a phase of oceanography training in Class A school. Sonar technicians are instructed on the subject of oceanography, environmental factors related to ASW and mine warfare, interspersed with other topics of their curricula.

7. There is a strong indication that the general level of knowledge of the ocean environment is inadequate among fleet personnel, both officer and enlisted.

8. The general level of knowledge of ocean environmental effects as related to underwater acoustics is inadequate among sonar technicians assigned to submarines, ASW surface ships, and mine warfare ships. As experience is gained, the sonar technicians' opinion of the adequacy of training school subject matter in environmental effects on sound propagation decreases. The magnitude of the problems encountered is not recognized by the lower paygrades.

9. AN/SQS-26 sonar technicians are receiving better training on the environmental effects on sound propagation than are AN/SQS-23 sonar technicians.

10. The lack of submarine services for fleet training is the most significant deficiency in the present training of sonar technicians.

11. There is neither a correspondence course nor programmed instruction material available to enlisted personnel for the specific study of the environmental effects of the oceans on underwater acoustics. Training information for self-study has to be gleaned from numerous sources.

12. The sources of education in oceanography for enlisted personnel are few in number. The best source is the United States Armed Forces Institue. Selection of sensor operators for the ADCOP program with education provided in a field related to their ratings would be the best education source.

13. By the nature of the action taken on the Operational Oceanographic Support Services Conference training and education recommendations, the Commander, Naval Weather Serivce Command has indicated a lack of interest in increasing the basic knowledge level of fleet personnel about the subject of the ocean environment.

14. The enlisted ratings which require training in oceanography, in addition to STs and other ratings used for sonar watchstanders, are AG, AW, AX, MN, OT, QM, RD, TD, and TM.

15. Increased utilization in fleet schools of officers having an oceanography education, combined with fleet experience, would greatly increase the level of training of enlisted personnel.

B. RECOMMENDATIONS

1. Adopt the following recommended programs in the order presented. Details of the recommendations are contained in Section VI.

   a. Establish an ASW sensor operator rating and assign sonar technicians to solely maintenance duties.

   b. Provide training in applied oceanography for radarmen.

   c. Establish the proposed oceanographer rating.

   d. Implement a phase of recruit training on the topic of basic oceanography.

   e. Modify the Basic Quartermaster Course to include selected topics in applied Oceanography.

   f. Add subject material on the topics of pollution and the Navy Ocean Science Program to the Military Requirements rate training manual.

2. Provide actual shipboard training with a target submarine, in a realistic ASW situation, for an at-sea phase in sonar technician class A-1 school, operator training schools, and for further shipboard training after school completion. With the shortage of submarine target services, first priority for usage should be given to fleet ASW training exercises.

3. Conduct a study of ST performance in various training pipelines in order to relate school performance to on-the-job performance.

4. Assign prospective sonar technicians to the fleet for 6-12 months immediately upon completion of recruit training to gain fleet experience prior to assignment to Class A school on a returnable quota basis.

5. Stabilize enlisted personnel assignments to maintain the necessary level of proficiency in ASW.

6. Consolidate the myriad of publications on the topics of sonar range prediction, oceanography and underwater sound, and environmental effects on ASW. As a minimum, develop a reference publication which provides the location of the necessary information. Adopt standard distribution lists for the publications and a means for periodic review.

7. Develop programmed instructional material on the subject of oceanography as applied to underwater acoustics and sensor operation.

8. Redevelop a correspondence course for both officers and enlisted men that relates oceanography to antisubmarine warfare.

9. Develop rate training manuals and correspondence courses for OTs.

10. Establish ST Class C school course in applied oceanography, similar to the Aerographer's Mate Class C Air-Ocean Environment Course.

11. Expand ST Classification Schools with mandatory attendance required at regular intervals.

12. Increase the emphasis on underwater sound propagation, and the effects of the environment on ASW operations in the Class A-1 ST school curricula.

13. Provide a refresher course on at least an annual basis to update, reinforce, and augment the oceanography knowledge of the AWs.

14. Continue to provide the basic AW oceanography training to Class A school graduates by FASOTRAGRU's.

15. Provide better quality control and performance monitoring of instructors in enlisted training schools.

16. Assign officer oceanographers with a fleet ASW background as instructors in AW and ST schools in order to prevent the composite situation of ASW and the environmental effects of the ocean.

17. Standardize training course curricula format between the different training commands.

18. Encourage enlisted personnel to enroll in voluntary, off-duty education programs.

APPENDIX A

GLOSSARY OF TERMS

Billet: Under the concept of multiple duty assignment as a fundamental principle in the use of the Navy's manpower which requires that all naval personnel must perform several duty assignments which may be unrelated in terms of skills and knowledges, a billet may be defined as a cluster of assignments covering the routine, general quarters, and watch or other types of military duty.

Class A Schools: Schools, in general, designed to provide the basic technical knowledges and skills required to prepare personnel for the lower petty officer rates (pay grades).

Class B Schools: Schools designed to provide the advanced technical knowledges and skills required to prepare personnel for the higher petty officer rates (pay grades).

Class C Schools: Schools designed to train enlisted personnel in a particular skill or technique which, in general, is not peculiar to any one rating (broad occupational field).

Class P Schools: Schools designed to conduct training at a basic and preparatory level.

Corrective Maintenance: The action required to restore failed equipment to an operational status within prescribed tolerances/limitations/capabilities.

Duty: A group of closely related tasks that constitute the largest subdivision of a billet.

Enlisted Occupational Classification System: The Navy's Enlisted Occupational Classification System consists of three major subsystems: (1) Enlisted Rating Structure, (2) Navy Enlisted Classification (NEC) Structure, and (3) Special Qualifications. The first subsystem, Enlisted Rating Structure is the primary administrative tool for broad classification, identification, and reporting of enlisted personnel resources and requirements. The Enlisted Rating Structure consists of rates and ratings that are the framework for enlisted career development. The second subsystem, NEC Structure, supplements the Enlisted Rating Structure by identifying special skills and knowledges that require a more refined or specific identification than is provided by rates and ratings. The third subsystem, Special Qualifications, identifies several highly specialized occupational entities, crosses several occupational fields, and requires official identification for certain purposes. The Special Qualifications are contained in the Bureau of Naval Personnel Manual.

Enlisted Rating Structure: Administrative tool for classification, identification, and reporting of enlisted personnel and is comprised of general ratings, service ratings, and emergency ratings.

FAAWTC: Fleet Anti-Air Warfare Training Center.

FLEASWSCOL: Fleet Antisubmarine Warfare School.

Fleet Schools Ashore: Shore-based fleet training activities, assigned to the command of fleet commanders, which provide refresher and team training to fleet personnel who normally are members of ship's companies.

FSS: Fleet Sonar School.

FTC: Fleet Training Center

Functional Schools: Schools, in general, designed for the training of enlisted personnel as well as officers. These schools provide training to personnel, often in a group or team situation, in the performance of specialized tasks or functions which are not normal to rating training of enlisted personnel nor to professional training of officers. These schools also provide training on weapons of new or advanced design which have not reached universal fleet usage.

General Rates (Apprenticeships): SR/SA/SN, FR/FA/FN, AR/AA/AN, CR/CA/CN, DR/DA/DN, HR/HA/HN, and TR/TA/TN are used to identify enlisted personnel at paygrade E-1/E-2/E-3.

General Ratings: Broad occupational fields, encompassing similar duties and functions, which require related patterns of aptitudes and qualifications, and which provide paths of advancement for career development. These ratings identify personnel from paygrades E-4 through E-9 and are applicable to both the Regular Navy and Naval Reserve. They provide

the primary means of identifying billet requirements and personnel qualifications and are provided with distinctive rating badges. There are two types of general ratings, those with no subspecialties or service ratings and those with service ratings. Boatswain's Mate is an example of a general rating which contains no service ratings.

LFTC: Landing Force Training Command.

Maintenance and Material Management (3-M): An integrated management system that provides for orderly scheduling and accomplishment of maintenance and for reporting and disseminating significant maintenance related information. The 3-M System is composed of two subsystems: The Planned Maintenance Subsystem (PMS), and the Maintenance Data Collection Subsystem (MDCS).

NATTC: Naval Air Technical Training Command.

NAVPHIBSCOL: Naval Amphibious School.

NAVSUBTRAFAC: Naval Submarine Training Facility.

Navy Enlisted Classification Codes (NEC's): Four-digit codes which, within the scope of the Navy Enlisted Classification System, supplement the Navy Enlisted Ratings Structure by identifying requirements for and resources of special skills and knowledges which cannot be adequately identified by rate or rating alone. NEC's are of three major types:

Rating Entry NEC's; Rating series NEC's (those which are related to specific ratings); and Special Series NEC's (those not related to specific ratings).

Non-returnable Quota: All personnel assigned quotas to courses of instruction 20 weeks or longer are transferred to duty under instruction which is considered a permanent change of duty. Upon completion of schooling these personnel are assigned a new permanent duty station by the Chief of Naval Personnel.

Occupational Groups: Broad classifications of occupationally or organizationally related ratings. The rating structure is divided into the following occupational groups: Group I - Deck; Group II - Ordnance; Group III - Electronics; Group IV - Precision Equipment; Group V - Administrative and Clerical; Group VI - Miscellaneous; Group VII - Engineering and Hull; Group VIII - Construction; Group IX - Aviation; Group X - Medical; Group XI - Dental; and Group XII - Steward.

Paygrade: Paygrades are levels established by legislation for purposes of pay and allowances. Navy paygrades are designated: master chief petty officer (E-9); senior chief petty officer (E-8); chief petty officer (E-7); petty officer first class (E-6); petty officer second class (E-5); petty officer third class (E-4); and paygrades applicable to general rates, such as seaman (E-3); seaman apprentice (E-2); and seaman recruit (E-1).

Planned/Preventive Maintenance: Those preventive maintenance actions performed on equipment to maintain uninterrupted operation within design characteristics or to detect and/or prevent failures before they occur. Planned Maintenance refers to preventive maintenance accomplished on a regular periodic basis.

Rate: Identifies personnel occupationally by paygrade. Within a rating, a rate reflects levels of aptitude, training experience, knowledge, skills, and responsibilities; e.g., Boatswain's Mate is a rating, whereas Boatswain's Mate Third Class is a rate within a rating.

Returnable Quota: Quotas assigned only for personnel going to courses of instruction of less than 20 weeks duration when it is desired that upon completion or separation the man be returned to the originating command.

Service Ratings: Subdivisions of certain general ratings which by delineating specific areas of qualifications, provide for required specialization in training and utilization of personnel. They are applicable to personnel of both the Regular Navy and Naval Reserve, and the rating badge is the same as that of the general rating with which associated. Electronics Technician is a general rating, but within its scope it contains two service ratings; namely, Electronics Technician, Communications (N) and Electronics Technician, Radar (R) at the E-4 and E-5 paygrades.

SSC: Service School Command.

Task: A group of closely related work elements which constitute an integral step in the performance of a duty.

Troubleshooting: Act of locating and diagnosing malfunctions or breakdowns in equipment by means of systematic checking and analysis.

APPENDIX B

QUALIFICATIONS FOR ADVANCEMENT IN RATING AND NORMAL PATHS OF ADVANCEMENT

The minimum professional and military qualifications for advancement of all enlisted personnel are contained in the Manual of Qualifications for Advancement [8]. The manual serves as the basic reference for the preparation of training courses, training publications, on-the-job training programs, and school curricula. The minimum standards for advancement to pay grades E-2 through E-9 are expressed in practical and knowledge factors. The manual also serves as a basic reference for the assignment and utilization of enlisted personnel, assistance to activities submitting changes to manpower authorizations, reflecting paths of progression for enlisted career fields, preparation of manpower Authorizations (OPNAV 1000/2) which establishes for each activity the quality and quantity of enlisted personnel required to carry out its mission, and conduct of rating structure studies by the Rating Review Board and Rating Policy Board. The standards in the manual consist of minimum knowledge and abilities which enlisted personnel must acquire for advancement to successive pay grades. The standards do not necessarily cover all duties of a rating. They are based upon minimum essential tasks and knowledges which are required of a majority of men at a given rate.

The standards consist of qualification items which are essential prerequisites, universally applicable and minimum for each pay grade. The standards are designed to be flexible. They do not restrict or limit the utilization of personnel. The standards are based on general responsibility levels. A qualification is graded at the level which has the "responsibility" for the task or knowledge.

The Navy's requirements for enlisted minimum skills are contained in two types of minimum standards.

1) Military Standards consist of qualifications (knowledge and practical factors) which specify the skills and knowledge required of enlisted personnel as a minimum for advancement to specific pay grades, in addition to the occupational standards for general rates and ratings.

2) Occupational Standards specify the skills and knowledge which apply to enlisted personnel as a minimum for advancement in a specific general rate or rating in addition to the military standards. These standards are divided into practical and knowledge factors and are presented as individual qualification items.

Practical factors specify those required skills which can be measured and which are best judged by actual performance. They are intended to measure knowledge in action over a continuing period of time. Knowledge factors are items which can best be tested through the medium of written examination. Knowledge factors and knowledge aspects of practical factors form the basis of questions contained in the service wide advancement in rating examinations.

A numbering system has been adopted [8] to give greater stability to the identification of each qualification item. The numbers used in the Manual of Qualifications for Advancement numbering system will be used in this appendix to identify the qualification items. The prefix number '1' refers to a practical factor and the prefix number '2' refers to a knowledge factor.

The qualification items, for the ten ratings previously identified in this study, which are directly applicable to oceanography or related to oceanography are presented in the following sub-sections. The paygrade the qualification is required for advancement to is indicated.

A. MILITARY STANDARDS FOR ADVANCEMENT

Scope. Military Standards are those generally applicable qualifications which all enlisted personnel are expected to demonstrate as a minimum for advancement to specific pay grades. A military standard can be applied to questions of a military nature and those pertaining to the work of a general rate or rating. In those cases, an occupational standard is not developed to duplicate a military standard.

QUALIFICATIONS FOR ADVANCEMENT [8]

D. INTERNATIONAL AGREEMENTS

2.81	Role of the U.S. Navy in maritime nature of the free world alliance.	E-8

AA. SEA POWER

2.41	Basic factors and applications of naval power that have affected national survival.	E-4

2.61	Roles and missions of the Navy.	E-6

CC. ENVIRONMENTAL POLLUTION CONTROL

2.21	Causes of pollution in the air, water, and land.	E-2
2.22	Effects of pollutants on air, water, and land.	E-2
2.23	Effect of water, air, and land pollutants and pollution on human beings and other living organisms	E-2
2.24	Effects of insecticides, herbicides, and pesticides on the balance of nature	E-2
2.25	Procedures for eliminating or minimizing adverse effects of environmental pollution.	E-2
2.26	Procedures for controlling or minimizing environmental pollution.	E-2

B. OCCUPATIONAL STANDARDS FOR ADVANCEMENT

1. General Rates

The general rates of Airman (AN) and Seaman (SN) are the sources of enlisted personnel for career development in the applicable ratings for which qualification items are given.

2. Occupational Groups

Groups are numbered the same as in [8].

a. Group I Deck

OCEAN SYSTEMS TECHNICIAN (OT)

NOTE: The qualifications for advancement as Ocean Systems Technician (OT) are issued separately as supplement No. 2 to the Manual of Qualifications for Advancement, NAVPERS 18068C (c).

QUARTERMASTER (QM)

Scope: Quartermasters stand watch as assistants to officers of the deck and to the navigator; serve as steersmen and perform ship control, navigation, and bridge watch duties; procure, correct, use and stow navigational and oceanographic publications and oceanographic charts; maintain navigational instruments and keep correct navigational time; render "honors and ceremonies" in accordance with national observance and foreign customs; send and receive visual messages; and serve as petty officers in charge of tugs, self-propelled barges, and other yard and district craft.

QUALIFICATIONS FOR ADVANCEMENT [8]

I. NAVIGATION AND RELATED EQUIPMENT

1.04	Operate depth sounder (Fathometer); mark echogram and annotate for time, course, and speed changes; enter soundings in sounding journel.	E-4
2.61	Effects of prevailing winds and currents on ship navigation.	E-6

K. WEATHER

1.02	Make up numerical-code weather message, using current publications.	E-4
1.60	Interpret synoptic weather, wave, and ice charts and related messages.	E-6
2.41	Meteorology as it relates to navigation. Significance of dew point, relative humidity, temperature, atmospheric pressure, wind force and direction, cloud formation, and sea state in general weather forecasting.	E-5
2.60	Laws of cyclonic storms, including probable path and location of storm center. Indications of an approaching storm and action taken to avoid storm center.	E-6

Z. ADMINISTRATION

1.02	Obtain data and make entries in the bearing record book, compass record book, quartermaster's notebook, and weather Observation Sheet, using standard terminology, phraseology, and scale for wind, weather, sea, and clouds.	E-4

1.03 Prepare chart correction card (NAVOCEANO 5610/2); correct and stow charts; and identify symbols used on navigational charts. E-4

1.05 Use and apply data contained in Coast Pilots, Sailing Directions, Light Lists, and Tide and Current Tables commonly used in solving navigational problems. E-4

1.60 Obtain information and prepare the following oceanographic reports for shipments, in accordance with current directives: echograms, wave observation log, ship's ice log, sounding journal, and adjusted track charts. E-6

2.01 Names, uses, and types of navigational publications nad information supplied by Oceanographic office, Naval Observatory, Coast Guard, Bureau of Naval Personnel, and Coast and Geodetic Survey. E-4

2.41 Names and uses of chart projections and scales. E-5

RADARMAN (RD)

Scope: Radarmen interpret and evaluate presentations and tactical situations and make recommendations to superiors during watch conditions; apply a thorough knowledge of CIC doctrine and procedures contained in NWP and NWIP publications, tactical doctrine and procedures contained in ATP, NWP, and NWIP publications and procedures necessary for radar navigation contained in Naval Oceanographic Office publications; provide to command technical information and assistance related to Anti-Air Warfare (AAW), Antisubmarine Warfare (ASW), Naval Gunfire Support (NGFS), and Amphibious Warfare operations. (Scope in entirety is contained in [8].)

QUALIFICATIONS FOR ADVANCEMENT [8]

C. INTERPRETATION

1.01 Distinguish radar contacts caused by ships and aircraft from those caused by land, weather, and analogous propagation. E-4

E. NAVIGATION AND PLOTTING

2.01 Information to be gained from nautical charts, including symbols, topography, depth, and variation. E-4

G. CONTROL AND ASSIST

2.62	Procedures in ASW operations including internal and external communications requirement.	E-6

SONAR TECHNICIAN (ST)

Scope: (For general rating PO1 and CPO only) Sonar Technicians obtain and interpret underwater data for operational use; supervise the use and upkeep of sonar equipment; organize antisubmarine (A/S) attack teams; train and supervise personnel in their assignments; evaluate targets and interpret oceanographic data; evaluate equipment operation; locate and analyze equipment casualties and make repairs and adjustments; perform organizational and intermediate maintenance on surface sonar and allied equipment; and train personnel in all categories of equipment maintenance.
(For service ratings PO3 and PO2 only)
SONAR TECHNICIANS G (surface) operate (manipulate, control, evaluate, and interpret data) sonar and oceanographic equipment, surface ship underwater fire control equipment, and associated equipment for the solution of antisubmarine warfare problems; perform organizational and intermediate maintenance on surface sonar and allied equipment.
SONAR TECHNICIANS S (submarine) operate (manipulate, control, evaluate, and interpret data) submarine sonar and oceanographic equipment, submarine and sonar underwater fire control interface, and submarine auxiliary sonar; and perform organizational and intermediate maintenance on submarine sonar and allied equipment.

QUALIFICATIONS FOR ADVANCEMENT [8]

B. DETECTION EQUIPMENT

1.03	Identify sounds produced by surface ships, torpedoes, snorkeling submarines, evasion devices, equipment on submarine or ship, marine life, and other natural phenomena.	E-4(STG,STS)
1.05	Interpret passive sonar recorder traces.	E-4(STG,STS)
1.09	Operate sonar equipment effectively under varying acoustical conditions.	E-4(STG,STS)
1.11	Operate and adjust sonar equipment during antisubmarine operations.	E-4(STG,STS)

2.01	Nomenclature, function and capabilities of:	
	a. surface sonar equipment	E-4(STG)
	b. submarine sonar equipment	E-4(STS)
	c. mine detection equipment	E-4(STG,STS)
2.04	Effect of water phenomena on sonar.	E-4(STG,STS)

F. BATHYTHERMOGRAPH

1.01	Take bathythermograph readings.	E-4(STG,STS)
1.03	Operate and maintain bathythermograph as associated equipment.	E-4(STG,STS)
1.05	Interpret acoustic conditions to determine effective sonar range.	E-4(STG,STS)
1.40	Interpret acoustic conditions to determine best submarine conditions to avoid detection.	E-4(STG,STS)
1.41	Prepare and interpret sonar messages	E-4(STG,STS)

G. ANTISUBMARINE OPERATIONS

1.09	Recognize and classify contacts (warship, nuclear, and conventional submarine, light craft, merchant)	E-4(STS)
1.41	Determine figures -of-merit for various contacts and ocean conditions using various sonar equipment.	E-5(STS)
2.01	Description, recognition, and classification of A/S contacts.	E-4(STG,STS)
2.02	Description, recognition, and classification of surface contacts	E-4(STS)
2.03	Description, recognition, and classification of jamming devices, torpedoes and active transmissions.	E-4(STG,STS)
2.40	Passive figure-of-merit	E-5(STS)
2.41	Active figure-of-merit	E-5(STS)
2.42	Signal to noise ratio measurement	E-5(STS)
2.43	External and internal causes of signal loss and degradation	E-5(STG,STS)
2.44	Active performance figure	E-5(STG)

2.61	Capabilities and limitations of A/S equipment.	E-6
2.62	Figure-of-merit equation	E-6
2.63	Sonar conditions and target characteristics.	E-6

H. MAINTENANCE

1.42	Perform receiving sensitivity, noise level, and source level measurements.	E-5(STG,STS)

Z. ADMINISTRATION

1.80	Organize, supervise, and train personnel in operation, maintenance, and repair of sonar, underwater fire control, and allied equipment.	E-7

SENIOR CHIEF SONAR TECHNICIAN (STCS)

1.92	Evaluate contact information and make classification and tactical recommendations.	E-8
2.91	Procedures used in, and results of, experiments in A/S doctrine.	E-8
2.94	Capabilities, limitations, and characteristics of currently used surface and sub-surface sonars.	E-8

MASTER CHIEF SONAR TECHNICIAN (STCM)

1.95	Provide command with technical information and advice concerning the operational employment, capabilities, and limitations of sonar equipment.	E-9
1.97	Direct sonar activity in any A/S exercise or attack	E-9

b. Group II Ordnance

MINEMAN (MN)

Scope: Mineman test, maintain at an intermediate level, repair, and overhaul mines and their components planted by naval vessels and aircraft; assemble, test, handle, issue, and deliver mines to the planting agent; maintain at an organizational level and repair mine-handling and mine-planting equipment.

QUALIFICATIONS FOR ADVANCEMENT [8]

D. BASIC ELECTRICITY, ELECTRONICS, AND DETECTION INFLUENCES

2.02 Elementary physics of sound, fluid, electricity, heat, inertia, and gravity. E-4

2.62 Principles of transmission of underwater sound and its effect on mine warfare operations. E-6

F. HANDLING AND PLACEMENT

2.01 Methods of planting, position in water, and principles of actuation of mines. E-4

2.82 Effects of hydrographic and oceanographic conditions on mines. E-7

SENIOR CHIEF MINEMAN (MNCS)

1.90 Provide technical information and advice concerning uses and capabilities of mobile mine propulsion units, mines, mine components, and associated equipment. E-8

MASTER CHIEF MINEMAN (MNCM)

1.97 Supervise operations and procedures concerned with the tactical employment of underwater mine systems and installations. E-9

2.96 New trends in underwater mine equipment, installations, and systems. E-9

2.99 Operational considerations in mine warfare and mine field planning. E-9

TORPEDOMAN'S MATE (TM)

Scope: Torpedoman's Mates perform organizational and intermediate maintenance on underwater ordnance such as torpedoes and antisubmarine rockets (SUBROC/ASROC), launched from surface ships, submarines, and aircraft; operate and maintain test equipment, launching/firing systems, and stowage facilities associated with underwater ordnance; prepare underwater ordnance for launching; and conduct postfiring routines, and securing and evaluation procedures.
NOTE: Some qualification items are assigned an abbreviation of TECH, SUB, or SURF or a combination of these abbreviations. If there is no abbreviation at the end of a qualification, the item applies to all Torpedomen's mates.

QUALIFICATIONS FOR ADVANCEMENT [8]

C. TORPEDO PROPULSION AND CONTROL MECHANISM

2.01 b.	Principles and functions of acoustically controlled torpedoes and their components.	E-4

E. BASIC ELECTRICITY, ELECTRONICS, AND ACOUSTICS

2.06	Elementary physics of sound, fluids, electricity, heat, inertia and gravity.	E-4

SENIOR CHIEF TORPEDOMAN'S MATE (TMCS)

1.90	Provide technical information and advice concerning uses and capabilities of torpedoes, and associated equipment.	E-8
2.92	Common weaknesses in underwater ordnance equipment and systems.	E-8
2.941	Tactical and operational utilization of undersea weapons and launching systems.	E-8

MASTER CHIEF TORPEDOMAN'S MATE (TMCM)

1.96	Supervise operations and procedures concerned with the tactical employment of underwater ordnance systems and installations.	E-9
2.95	Capabilities and limitations of all underwater ordnance and underwater ordnance installations.	E-9
2.96	New trends in underwater ordnance equipment, installations, and systems.	E-9

c. Group IX Aviation

AEROGRAPHER'S MATE (AG)

Scope: Aerographer's mates observe, collect, record, and analyze meteorological and oceanographic data; make visual and instrumental observations of weather and sea conditions; operate meteorological satellite receivers and interpret and apply satellite data; interpret meteorological and oceanographic codes and enter data on appropriate charts; operate ancillary computer equipment for the processing, dissemination and display of environmental data; perform preventive maintenance on meteorological and oceanographic equipment; prepare warnings of severe and hazardous weather and sea conditions; forecast meteorological and oceanographic conditions; and prepare and present briefings concerning current and predicted environmental conditions and their effect on operations.

QUALIFICATIONS FOR ADVANCEMENT [8]

B. INSTRUMENTS AND EQUIPMENT

2.02	Purpose and uses of mechanical and electrical meteorological and oceanographic equipment.	E-4
2.40	Purposes and uses of electronic meteorological and oceanographic equipment.	E-5

C. OBSERVATION

2.01	Procedures and methods for observing, recording and preparing for transmission surf, wave and swell observations.	E-4
2.04	Principles of bathythermograph operations	E-4

D. CODES AND PLOTTING

1.03	Decode and plot wave and swell bathythermograph, and sea surface temperature reports.	E-4
2.01	Common meteorological and oceanographic codes and symbols.	E-4
2.02	Use of publications containing instructions for encoding and decoding environmental data.	E-4

E. ANALYSIS, PROGNOSIS, AND FORECASTING

1.42	Interpret oceanographic analyses, prognoses, and forecasts for operational use.	E-5

1.43	Analyze bathythermograph data for mixed/sonic layer depth, thermal gradients, and sound channels.	E-5
1.44	Analyze sea condition charts showing contours of sea heights and general direction of seas.	E-5
1.64	Prepare weather and sea condition (surf; wave and swell) forecasts for air and sea operations (up to 48 hours).	E-6
1.84	Prepare and conduct briefings at staff or planning levels with particular emphasis on climatological, meteorological, and oceanographic data.	E-7
2.40	Principles of analysis of coded bathythermograph, Nansen cast and other oceanographic data.	E-5
2.62	Principles of air-sea interaction and ocean thermal structure forecasting.	E-6
2.63	Forecasting techniques for ASWEPS and sensor ranges.	E-6

F. METEOROLOGY, OCEANOGRAPHY, AND CLIMATOLOGY

2.03	Terminology and definitions of meteorological and oceanographic parameters.	E-4
2.42	Physical properties of sea water; major oceanographic parameters (sea surface temperature, mixed layer depth, and temperature gradient with depth); major current systems and water masses of the oceans.	E-5
2.61	Ocean thermal structure and factors affecting the underwater transmission of sound.	E-6
2.63	Wave and swell generation and propagation.	E-6
2.64	Modes of operation of and effects of environmental conditions on active/passive sonar and sonobuoy systems; tactical range prediction.	E-6
2.80	Meteorological and oceanographic climatology of the world.	E-7

2.81	Application of computer products and technology to the environmenta sciences.	E-7

SENIOR CHIEF AEROGRAPHER'S MATE (AGCS)

1.92	Evaluate recent meteorological and oceanographic developments for integration into local routines.	E-8

MASTER CHIEF AEROGRAPHFR'S MATE (AGCM)

1.95	Assist in the statistical analysis of climatological data and provide technical information concerning its uses, capabilities, and limitations.	E-9
1.96	Prepare on Environmental Annex for an Operation Order as a supplement to existing Naval Weather Service Command directives.	E-9
1.97	Provide technical information and advice concerning the operational use, capabilities, limitations and reliability of meteorological and oceanographic equipment.	E-9

AVIATION ANTISUBMARINE WARFARE OPERATOR (AW)

Scope: Aviation Antisubmarine Warfare Operators are aircrewmen in permanent flight status. They man sensor positions in fixed and rotary wind ASW aircraft based ashore and aboard aircraft carriers, escort vessels, and Sea Control ships. They serve as analysts in ASCACs and Tactical Support Centers. They may perform collateral aircrew duties in rescue, utility, and missile defense aboard multipurpose aircraft with an ASW mission.
NOTE: The qualifications for advancement as Aviation Antisubmarine Warfare Operator (AW) are issued separately as supplement No. 3 to the Manual of Qualifications for Advancement, NAVPERS 18068 C (C).

AVIATION ANTISUBMARINE WARFARE TECHNICIAN (AX)

Scope: Aviation Antisubmarine warfare technicians inspect and maintain aircraft, antisubmarine warfare systems and equipment, including those related to magnetic anomaly detection, long and short range underwater detection, nuclei detection, integrated displays, and associated ASW equipment; and test and maintain test equipment.

QUALIFICATIONS FOR ADVANCEMENT [8]

D. THEORY AND PRINCIPLES

2.06	Elementary physics of heat, light, sound, fluids, and gases.	E-4
2.39	Principles and applications of:	
	a. Sonar	E-4
	b. Jezebel	E-4
	c. Julie	E-4

SENIOR CHIEF AVIATION ASW TECHNICIAN (AXCS)

1.944	Collect, process, and analyze ASW data.	E-8
2.946	Analysis and evaluation processes of Anti-Submarine combat Analysis Centers (ASCAC).	E-8

TRADEVMAN (TD)

Scope: Tradevmen install, repair, modify, and maintain audio/visual training aids; perform organizational and intermediate level maintenance on training devices; operate and perform organizational maintenance on equipment used in conjunction with training devices; operate training devices and ancillary equipment to train and maintain the proficiency of individuals and/or teams; assist in the development, operation, and/or improvement of training programs of supported activities; and construct, devise, or obtain training aids.

QUALIFICATIONS FOR ADVANCEMENT [8]

B. TRAINING DEVICE OPERATION

2.42	Fundamentals of ship and submarine operation.	E-5
2.43	Applications of sensors, types, uses and interpretation of sensor indicators	E-5
2.44	Fundamentals of surface and subsurface weapon systems.	E-5

F. THEORY AND PRINCIPLES

2.06	Elementary physics of heat, light, sound, fluids, gases, and electricity.	E-4

MASTER CHIEF TRADEVMAN (TD)

2.95	Advanced requirements for trai ing, personnel, and training device installation.	E-9
2.98	Procedures for the development of requirements and specifications for training devices and systems.	E-9

C. NORMAL PATHS OF ADVANCEMENT

The normal path of advancement from petty officer third class to master chief petty officer for the ten ratings listed in the preceding sub-section are shown in Figure 21. The normal paths of advancement to warrant and limited duty officer are shown in Figure 22.

RATING TITLE	ABBREVIATION	PO3 (E-4)	PO2 (E-5)	PO1 (E-6)	CPO (E-7)	SCPO (E-8)	MCPO (E-9)
	GROUP I - DECK						
Ocean Systems Technician	OT	OT3	OT2	OT1	OTC	OTCS	OTCM
Quartermaster	QM	QM3	QM2	QM1	QMC	QMCS	QMCM
Radarman	RD	RD3	RD2	RD1	RDC	RDCS	RDCM
Sonar Technician	ST			ST1	STC	STCS	STCM
Sonar Technician G (surface)	STG	STG3	STG2				
Sonar Technician S (submarine)	STS	STS3	STS2				
	GROUP II - ORDNANCE						
Mineman	MN	MN3	MN2	MN1	MNC	MNCS	MNCM
Torpedoman's Mate	TM	TM3	TM2	TM1	TMC	TMCS	TMCM
	GROUP IX - AVIATION						
Aerographer's Mate	AG	AG3	AG2	AG1	AGC	AGCS	AGCM
Aviation Antisubmarine Warfare (ASW) Operator	AW	AW3	AW2	AW1	AWC	AWCS	AWCM
Aviation Antisubmarine Warfare (ASW) Technician	AX	AX3	AX2	AX1	AXC	AXCS	AXCM
Tradevman	TD	TD3	TD2	TD1	TDC	TDCS	TDCM

Figure 21. Normal Path of Advancement from PO3 to MCPO [8].

Enlisted Rating	Warrant Officer Category and Designator	Limited Duty Officer Category and Designator
Quartermaster	Boatswain 713X	Deck 600X
Ocean Systems Technician Quartermaster Radarman Sonar Technician	Operations Technician 714X	Operations 601X
Torpedoman's Mate Mineman	Underwater Ordnance Technician 733X	Ordnance 615X
Ocean Systems Technician Radarman Sonar Technician	Electronics Technician 766X	Electronics 640X
Aerographer's Mate	Aerographer 821X	Meteorology 665X
Aviation Antisubmarine Warfare Operator	Aviation Antisubmarine Warfare Operator 763X	Aviation Antisubmarine Warfare 681X
Aviation Antisubmarine Warfare Technician Tradevman	Aviation Electronics Technician 761X	Avionics 680X

Figure 22. Normal Paths of Advancement to WO and LDO [8].

APPENDIX C

NAVY ENLISTED CLASSIFICATIONS

nual of Navy Enlisted Classifications is the anual for NEC (Navy Enlisted Classifications) Code tion of enlisted personnel and requirements [37]. nlisted Classification Structure supplements the ating Structure in identifying personnel on active e duty and billets in manpower authorizations. ted Classifications reflect special knowledge and t identify personnel and requirements when the ucture (general, service, and emergency ratings) cient by itself for manpower management purposes. y, the applicable NEC's supplementing the identi- f the ten ratings presented in Section II, as requiring training in oceanography, are listed in dix. The applicable source rating and course of n for the rating series NEC are found in the Manual listed Classifications. NECs not related to any general or service rating are known as Special s. These are used to identify billet requirements not sufficiently identified by rates, and to iden- fied personnel. The applicable Special Series NECs ncluded in this appendix.

RATINGS

<u>grapher's Mate</u>

- 7412 Analyst - Forecaster
- 7424 ASWEPS Technician

<u>tion Antisubmarine Warfare Operator</u>

- 7811 Acoustic Operator
- 7815 ASCAC Operator
- 7821 Improved System Acoustic Operator
- 7825 Tactical Support Center Operator
- 7851 Non-Acoustic Operator
- 7861 Improved System Non-Acoustic Operator
- 7871 Multipurpose System Operator
- 7872 Combined Systems Operator
- 7881 Sonar Systems Operator

<u>n Systems Technician</u>

- 0611 Ocean Systems - Basic Analyst
- 0612 Ocean Systems - Advanced Analyst
- 0613 TASS Operator
- 0623 TASS Technician
- 0631 Ocean Systems - Senior Analyst

<u>termaster</u>

one)

<u>rman</u>

0341 Naval Warfare Operations Specialist

<u>r Technician</u>

- 0406 Underwater Object Locator (AN/UQS-1) Repairman
- 0408 Underwater Object Locator (AN/SQQ-14) Repairman and Operator
- 0409 Submarine Sonar (AN/BQG Series) Technician
- 0416 Sonar Intelligence Analysis Technician
- 0423 SSN Integrated Submarine Sonar System Technician
- 0425 AN/BQH-4 Equipment Technician
- 0427 General Submarine Sonar Maintenance Technician
- 0431 Underwater Fire Control (MK 111 (ASROC)) Technician
- 0434 Underwater Fire Control (MK 114 (ASROC)) Technician
- 0435 Underwater Fire Control (MK 114/Mod 9 (Terrier/ASROC)) Technician
- 0439 Underwater Fire Control (MK 105/Mods 11-28) Technician

ST - 0451 Surface Sonar (AN/SQS - 23) Technician
ST - 0452 Surface Sonar (AN/SQS - 26 BX (EDO)) Technician
ST - 0453 Surface Sonar (AN/SQS - 26AX(R) Technician
ST - 0454 Surface Sonar (AN/SQS - 26CX) Technician
ST - 0455 Surface Sonar (AN/SQS - 39 - 46) Technician
ST - 0456 Surface Sonar (AN/SQS - 35 IVDS) Technician
ST - 0459 Surface Sonar (AN/SQQ - 23 PAIR) Technician
ST - 0475 Surface Sonar Fire Control System (MK111 (ASROC)(AN/SQQ - 23)) Technician
ST - 0477 Surface Sonar Fire Control System (MK 114 (ASROC)(AN/SQQ - 23)) Technician
ST - 0481 Surface Sonar Fire Control System (MK 114 (ASROC)(AN/SQS - 26AX)) Technician
ST - 0482 Surface Sonar Fire Control System (MK 114 (ASROC)(AN/SQS - 26BX) Technician
ST - 0483 Surface Sonar Fire Control System (MK 114 (ASROC)(AN/SQS - 26CX)) Technician
ST - 0484 Surface Sonar Fire Control System (MK 114 (ASROC)(AN/SQS - 23)) Technician
ST - 0487 Surface Sonar Fire Control System (MK 111 (ASROC)(AN/SQS - 23)) Technician
ST - 0491 Surface Sonar Fire Control System (MK 114/ Mod 9 (Terrier/ASROC)(An/SQS - 26AX)) Technician
ST - 0492 Surface Sonar Fire Control System (MK 114/ Mod 9 (Terrier/ASROC)(AN/SQS - 26BX)) Technician
ST - 0493 Surface Sonar Fire Control System (MK 114/ Mod 9 (Terrier/ASROC)(An/SQS - 26CX)) Technician
ST - 0496 Surface Sonar Fire Control System (MK 105) (AN/SQS - 23) Technician
ST - 0497 Surface Sonar Fire Control System (MK 105) (AN/SQS - 39 - 46) Technician
ST - 0498 Advanced ASW Systems Technician

B. SECONDARY RATINGS

1. Aviation Antisubmarine Warfare Technician

AX - 6523 Aviation ASW (Jezebel) Technician
AX - 6527 Aviation ASW (Airborne Sonar) Technician
AX - 6529 Aviation ASW (Jezebel/Julie) Technician
AX - 6567 P-3C Acoustic Sensors System Technician
AX - 6569 Tactical Support Center Technician

2. Mineman

(none)

3. Tradevman

TD - 7502 ASW Attack Trainer Technician
TD - 7513 Combat Information Training Devices (Non-digital) Technician
TD - 7514 Combat Information Training Devices (Digital) Technician

4. Torpedoman's Mate

(none)

C. SPECIAL SERIES (DIVERS)

5311 Deep Dive Systems Diver
5321 Underwater Demolition Team Swimmer
5322 Underwater Demolition Team Swimmer/Explosive Ordnance Disposal Technician
5326 Combatant Swimmer, SEAL Team
5346 Master Saturation Diver

APPENDIX D

SURVEY RESULTS

In conducting this study, three opinion-type surveys were distributed to ships and aircraft squadrons. The results of the three surveys are presented in this appendix.

A. SONAR TECHNICIAN SURVEY

The sonar technician (ST) survey forms were distributed to 76 randomly selected ASW surface ships, submarines, and mine warfare ships. The purpose of the survey form was to determine the extent of the ST's training in oceanography-related subject areas and additionally to obtain personal background information. Responses were received from 70% (53/76) of the ships surveyed. The responses by ship type were as follows:

SURFACE ASW	36/46	-	78%
MINE WARFARE	7/10	-	70%
SUBMARINES	10/20	-	50%

It was interesting to note that responses were received from 14 of 16 (87.5%) of the AN/SQS-26 sonar equipped ships selected for the survey. Twenty-seven of the 53 ships responding are assigned to the Pacific Fleet and 26 to the Atlantic Fleet.

Based on the sonar technician allowance for each ship type and the response percentage from previous surveys, the

survey forms were mailed in sufficient quantity for an anticipated response of 5% of the total sonar technician strength. A sampling of 7% of the ST strength actually participated in the survey. A total of 415 survey forms were returned. Eleven forms were incomplete primarily due to non-attendance of the individual at sonar technician training schools. This was a requirement for completing the major portion of the survey form. The only E-9 responding declined to complete the form since he attended Class A school in 1953, which he believed was too long ago to be pertinent to this study. The distribution of the total sonar technician response by paygrade and ship type is found in Tables II and III. The distribution by paygrade and sonar type for the AN/SQS-23 and AN/SQS-26 hull-mounted sonar ships is found in Table IV.

In order to establish the representativeness of the sample to the population, comparisons were made by paygrade distribution. A comparison of the sample versus population by paygrade can be found in Table V. All paygrades are represented except E-9. STG paygrades are better represented than the others. The relatively low representation of the E-4 and E-5 STS's is due to the lower percentage of response from the submarines surveyed.

The responses to the survey form included sonar technicians with the following Navy Enlisted Classification (NEC) codes. The NEC codes and corresponding titles are included in Appendix C.

TABLE II.

DESTROYER SONAR TECHNICIAN SURVEY OPINIONS CONCERNING ADEQUACY OF TRAINING RECEIVED IN SUBJECT AREAS.

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
	NUMBER AND PERCENTAGE RESPONDING BY PAYGRADE FOR ALL DESTROYER TYPE SHIPS.							
Number Responding	347	3	43	133	89	50	22	7
Percent	100%	0.9	12.4	38.3	25.6	14.4	6.3	2.0
1. Temperature effects on the sound velocity profile.								
not covered enough	69	0	5	24	18	16	5	1
	19.9%	0	11.6	18.0	20.2	32.0	22.7	14.3
covered enough	274	3	38	106	70	34	17	6
	79.0%	100	88.4	79.7	78.7	68.0	77.3	85.7
covered too much	4	0	0	3	1	0	0	0
	1.1%	0	0	2.3	1.1	0	0	0
2. Salinity effects on the sound velocity profile.								
not covered enough	79	0	8	29	20	15	6	1
	22.8%	0	18.6	21.8	22.5	30.0	27.3	14.3
covered enough	261	3	33	102	68	33	16	6
	75.2%	100	76.7	76.7	76.4	66.0	72.7	85.7
covered too much	7	0	2	2	1	2	0	0
	2.0%	0	4.7	1.5	1.1	4.0	0	0
3. Pressure effect on the sound velocity profile not covered enough.	90	1	9	32	20	21	6	1
	25.9%	33.3	20.9	24.1	22.5	42.0	27.3	14.3

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
covered enough	253	2	33	99	68	29	16	6
	72.9%	66.7	76.7	74.4	76.4	58.0	72.7	85.7
covered too much	4	0	1	2	1	0	0	0
	1.1%	0	2.3	1.5	1.1	0	0	0
4. Environmental conditions necessary for a surface duct.								
not covered enough	213	3	17	89	55	32	14	3
	61.4%	100	39.5	66.9	61.8	64.0	63.6	42.9
covered enough	131	0	25	42	34	18	8	4
	37.7%	0	58.1	31.6	38.2	36.0	36.4	57.1
covered too much	3	0	1	2	0	0	0	0
	0.9%	0	2.3	1.5	0	0	0	0
5. Environmental conditions necessary for a deep sound channel.	*			*				
not covered enough	232	2	18	93	60	39	16	4
	67.2%	66.7	41.9	70.9	67.4	78.0	72.7	57.1
covered enough	110	1	24	36	29	11	6	3
	31.9%	33.3	55.8	27.5	32.6	22.0	27.3	42.9
covered too much	3	0	1	2	0	0	0	0
	0.9%	0	2.3	1.5	0	0	0	0
6. Convergence zone transmission.	*			*				
not covered enough	207	1	18	77	54	36	17	4
	60.0%	33.3	41.9	58.8	60.7	72.0	77.3	57.1
covered enough	136	2	25	52	35	14	5	3
	39.5%	66.7	58.1	39.7	39.3	28.0	22.7	42.9
covered too much	2	0	0	2	0	0	0	0
	0.5%	0	0	1.5	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
7. Bottom bounce transmission.	*			*				
not covered enough	206	1	18	75	56	37	16	3
	59.7%	33.3	41.9	57.3	62.9	74.0	72.7	42.9
covered enough	134	2	24	52	33	13	6	4
	38.8%	66.7	55.8	39.7	37.1	26.0	27.3	57.1
covered too much	5	0	1	4	0	0	0	0
	1.4%	0	2.3	3.0	0	0	0	0
8. Shallow water sound transmission.	*		*	*	*	*	*	*
not covered enough	172	2	16	66	47	30	10	1
	52.3%	66.7	39.0	52.0	56.0	61.2	50.0	20.0
covered enough	154	1	25	60	36	18	10	4
	46.8%	33.3	61.0	29.1	42.8	36.7	50.0	80.0
covered too much	3	0	0	1	1	1	0	0
	0.9%	0	0	0.8	1.2	2.0	0	0
9. Surface reverberation (sea state, wind, and waves).								
not covered enough	107	1	9	31	33	24	7	2
	30.8%	33.3	20.9	23.3	37.1	48.0	31.8	28.6
covered enough	238	2	34	100	56	26	15	5
	68.6%	66.7	79.1	75.2	62.9	52.0	68.2	71.4
covered too much	2	0	0	2	0	0	0	0
	0.6%	0	0	1.5	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
10. Volume reverberation (including the Deep Scattering Layer).	*			*	*		*	
not covered enough	141	0	10	46	45	26	10	4
	41.0%	0	23.3	34.8	51.1	52.0	47.6	57.1
covered enough	201	3	33	84	43	24	11	3
	58.4%	100	76.7	63.7	48.9	48.0	52.4	42.9
covered too much	2	0	0	2	0	0	0	0
	0.6%	0	0	1.5	0	0	0	0
11. Bottom reverberation (irregularities on the ocean floor).	*						*	
not covered enough	130	1	11	42	36	27	9	4
	37.6%	33.3	25.6	31.6	40.4	54.0	42.9	57.1
covered enough	213	2	32	88	53	23	12	3
	61.6%	66.7	74.4	66.2	59.6	46.0	57.1	42.9
covered too much	3	0	0	3	0	0	0	0
	0.9%	0	0	2.2	0	0	0	0
12. Environmental conditions affecting absorption loss.								
not covered enough	145	1	15	53	39	27	8	2
	41.8%	33.3	34.9	39.8	43.8	54.0	36.4	28.6
covered enough	200	2	28	78	50	23	14	5
	57.6%	66.7	65.1	58.6	56.2	46.0	63.6	71.4
covered too much	2	0	0	2	0	0	0	0
	0.6%	0	0	1.5	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
13. Environmental conditions affecting scattering loss.								
not covered enough	130	1	13	46	36	24	8	2
	37.5%	33.3	30.2	34.6	40.4	48.0	36.4	28.6
covered enough	215	2	30	85	53	26	14	5
	61.9%	66.7	69.8	63.9	59.6	52.0	63.6	71.4
covered too much	2	0	0	2	0	0	0	0
	0.6%	0	0	1.5	0	0	0	0
14. Environmental conditions governing spreading (spherical, cylindrical, and dipolar).	*		*					
not covered enough	237	3	28	88	61	37	15	5
	68.5%	100	66.7	66.2	68.5	74.0	68.2	71.4
covered enough	106	0	14	42	28	13	7	2
	30.6%	0	33.3	31.6	31.5	26.0	31.8	28.6
covered too much	3	0	0	3	0	0	0	0
	0.9%	0	0	2.2	0	0	0	0
15. False targets.								
not covered enough	187	1	20	68	46	34	15	3
	53.9%	33.3	46.5	51.1	51.7	68.0	68.2	42.9
covered enough	155	2	22	62	42	16	7	4
	44.7%	66.7	51.2	46.6	47.2	32.0	31.8	57.1
covered too much	5	0	1	3	1	0	0	0
	1.4%	0	2.3	2.2	1.1	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
16. Biological noise.								
not covered enough	198	1	24	68	50	39	14	2
	57.1%	33.3	55.8	51.1	56.2	78.0	63.6	28.6
covered enough	145	2	18	64	37	11	8	5
	41.8%	66.7	41.9	48.1	41.6	22.0	36.4	71.4
covered too much	4	0	1	1	2	0	0	0
	1.1%	0	2.3	0.8	2.2	0	0	0
17. Effects of marine fouling on sound transmission.	*		*	*	*			
not covered enough	230	1	25	81	57	42	18	6
	67.3%	33.3	59.5	62.3	64.7	84.0	81.8	85.7
covered enough	112	2	17	49	31	8	4	1
	32.7%	66.7	40.5	37.7	35.2	16.0	18.2	14.2
covered too much	0	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0	0
18. Bottom sediments and acoustic properties of the ocean bottom.	*				*	*		
not covered enough	200	1	17	79	49	30	18	6
	58.1%	33.3	39.5	59.4	56.3	61.2	81.8	85.7
covered enough	142	2	25	53	38	19	4	1
	41.3%	66.7	58.1	39.8	43.7	38.8	18.2	14.3
covered too much	2	0	1	1	0	0	0	0
	0.6%	0	2.3	0.8	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
19. Topography of the ocean bottom (bathymetric features).								
not covered enough	249	3	23	93	64	45	15	6
	71.8%	100	53.5	69.9	71.9	90.0	68.2	85.7
covered enough	96	0	19	40	24	5	7	1
	27.7%	0	44.2	30.1	27.0	10.0	31.8	14.3
covered too much	2	0	1	0	1	0	0	0
	0.5%	0	2.3	0	1.1	0	0	0
20. Location and general characteristics of the current systems in the oceans.	*				*			
not covered enough	277	1	32	107	72	42	18	5
	80.1%	33.3	74.4	80.5	81.8	84.0	81.8	71.4
covered enough	66	2	10	26	15	7	4	2
	19.1%	66.7	23.3	19.5	17.0	14.0	18.2	28.6
covered too much	3	0	1	0	1	1	0	0
	0.8%	0	2.3	0	1.1	2.0	0	0
21. Ambient noise (sea surface noise, thermal noise, rain noise, terrestrial noise, etc.).								
not covered enough	195	1	17	75	49	35	13	5
	56.2%	33.3	39.5	56.4	55.1	70.0	59.1	71.4
covered enough	147	2	24	56	39	15	9	2
	42.4%	66.7	55.8	42.1	43.8	30.0	40.9	28.6
covered too much	5	0	2	2	1	0	0	0
	1.4%	0	4.7	1.5	1.1	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
22. Causes of varied salinity conditions in the oceans and areas expected to find these conditions.	*		*		*			
not covered enough	227	3	20	89	60	38	12	5
	65.8%	100	47.6	66.9	68.2	76.0	54.5	71.4
covered enough	113	0	21	44	27	10	10	1
	32.8%	0	50.0	33.1	30.7	20.0	45.5	14.3
covered too much	5	0	1	0	1	2	0	1
	1.4%	0	2.4	0	1.1	4.0	0	14.3
23. Daily and seasonal variations in temperature conditions.	*				*			*
not covered enough	163	1	17	69	40	22	10	4
	47.2%	33.3	39.5	51.9	45.5	44.0	45.5	66.7
covered enough	182	2	26	64	48	28	12	2
	52.8%	66.7	60.5	48.1	54.5	56.0	54.5	33.3
covered too much	0	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0	0
24. Ray path plotting.								
not covered enough	206	3	23	87	46	31	14	2
	59.4%	100	53.5	65.4	51.7	62.0	63.6	28.6
covered enough	114	0	17	34	37	13	8	5
	32.9%	0	39.5	25.6	41.6	26.0	36.4	71.4
covered too much	27	0	3	12	6	6	0	0
	7.7%	0	7.0	9.0	6.7	12.0	0	0

25. Effect of internal waves on sound transmission.	*		*			*		
not covered enough	280	2	29	114	70	41	18	6
	81.4%	67.7	69.0	85.7	78.7	85.4	81.8	85.7
covered enough	63	1	13	19	19	6	4	1
	18.3%	33.3	31.0	14.3	21.3	12.5	18.2	14.3
covered too much	1	0	0	0	0	1	0	0
	0.3%	0	0	0	0	2.1	0	0

* Indicates item was not completed by all respondents.

TABLE III.

SUBMARINE AND MINESWEEPER SONAR TECHNICIAN SURVEY OPINIONS CONCERNING ADEQUACY OF TRAINING RECEIVED IN SUBJECT AREAS.

SUBJECT AREAS	TOTAL	NUMBER AND PERCENTAGE RESPONDING BY PAYGRADE FOR SUBMARINES AND MINESWEEPERS					
		E-3	E-4	E-5	E-6	E-7	E-8
Number Responding							
Minesweeper	12	0	7	3	2	0	0
Submarine	44	3	10	13	11	6	1
Percent							
Minesweeper	100%	0	58.3	25.0	16.7	0	0
Submarine	100%	6.8	22.7	29.6	25.0	13.6	2.3
1. Temperature effects on the sound velocity profile.							
a. Minesweeper							
not covered enough	4		3	1	0		
	33.3%		42.9	33.3	0		
covered enough	8		4	2	2		
	66.7%		57.1	66.7	100		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	6	0	1	2	3	0	0
	13.6%	0	10.0	15.4	27.3	0	0
covered enough	37	3	9	11	7	6	1
	84.1%	100	90.0	84.6	63.6	100	100
covered too much	1	0	0	0	1	0	0
	2.3%	0	0	0	9.1	0	0

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
2. Salinity effects on the sound velocity profile.							
a. Minesweeper							
not covered enough	6		5	1	0		
	50.0%		71.4	33.3	0		
covered enough	6		2	2	2		
	50.0%		28.6	66.7	100		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	7	0	1	3	3	0	0
	15.9%	0	10.0	23.1	27.3	0	0
covered enough	35	3	9	9	7	6	1
	79.6%	100	90.0	69.2	63.6	100	100
covered too much	2	0	0	1	1	0	0
	4.5%	0	0	7.7	9.1	0	0
3. Pressure effect on the sound velocity profile.							
a. Minesweeper							
not covered enough	6		5	1	0		
	50.0%		71.4	33.3	0		
covered enough	6		2	2	2		
	50.0%		28.6	66.7	100		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	7	0	1	3	3	0	0
	15.9%	0	10.0	23.1	27.3	0	0
covered enough	36	3	9	10	7	6	1
	81.8%	100	90.0	76.9	63.6	100	100
covered too much	1	0	0	0	1	0	0
	2.3%	0	0	0	9.1	0	0

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
4. Environmental conditions necessary for a surface duct.							
a. Minesweeper							
not covered enough	11		7	2	2		
	91.7%		100	66.7	100		
covered enough	1		0	1	0		
	8.3%		0	33.3	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine	*	*					
not covered enough	20	1	7	4	5	2	1
	46.5%	50.0	70.0	30.8	45.4	33.3	100
covered enough	22	1	3	9	5	4	0
	51.2%	50.0	30.0	69.2	45.4	66.7	0
covered too much	1	0	0	0	1	0	0
	2.3%	0	0	0	9.1	0	0
5. Environmental conditions necessary for a deep sound channel.							
a. Minesweeper							
not covered enough	10		6	2	2		
	83.3%		85.7	66.7	100		
covered enough	2		1	1	0		
	16.7%		14.3	33.3	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine	*	*					
not covered enough	20	1	6	4	6	2	1
	46.5%	50.0	60.0	30.8	54.5	33.3	100
covered enough	22	1	4	9	4	4	0
	51.2%	50.0	40.0	69.2	36.4	66.7	0

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
covered too much	1	0	0	0	1	0	0
	2.3%	0	0	0	9.1	0	0
6. Convergence zone transmission.							
a. Minesweeper							
not covered enough	9		4	3	2		
	75.0%		57.1	0	0		
covered enough	3		3	0	0		
	25.0%		42.9	0	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine	*	*					
not covered enough	17	0	5	4	5	2	1
	39.5%	0	50.0	30.8	45.4	33.3	100
covered enough	25	2	5	9	5	4	0
	58.1%	100	50.0	69.2	45.4	66.7	0
covered too much	1	0	0	0	1	0	0
	2.3%	0	0	0	9.1	0	0
7. Bottom bounce transmission.							
a. Minesweeper							
not covered enough	9		4	3	2		
	75.0%		57.1	100	0		
covered enough	3		3	0	0		
	25.0%		42.9%	0	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine	*	*					
not covered enough	23	2	6	7	5	2	1
	53.5%	100	60.0	53.8	45.4	33.3	100
covered enough	19	0	4	6	5	4	0
	44.2%	0	40.0	46.2	45.4	66.7	0

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
covered too much	1	0	0	0	1	0	0
	2.3%	0	0	0	9.1	0	0
8. Shallow water sound transmission.							
a. Minesweeper							
not covered enough	* 7			* 4	3	0	
	63.6%			66.7	100	0	
covered enough	4			2	0	2	
	36.4%			33.3	0	100	
covered too much	0			0	0	0	
	0			0	0	0	
b. Submarine							
not covered enough	* 21	* 1	7	5	* 5	2	1
	50.0%	50.0	70.0	38.5	50.0	33.3	100
covered enough	21	1	3	8	5	4	0
	50.0%	50.0	30.0	61.5	50.0	66.7	0
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0
9. Surface reverberation (sea state, wind, and waves).							
a. Minesweeper							
not covered enough	3			1	2	0	
	25.0%			14.3	66.7	0	
covered enough	9			6	1	2	
	75.0%			85.7	33.3	100	
covered too much	0			0	0	0	
	0%			0	0	0	
b. Submarine							
not covered enough	12	0	2	3	5	2	0
	27.3%	0	20.0	23.1	45.4	33.3	0

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
covered enough	32	3	8	10	6	4	1
	72.7%	100	80.0	76.9	54.5	66.7	100
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0
10. Volume reverberation (including the Deep Scattering Layer).							
a. Minesweeper							
not covered enough	5		3	2	0		
	41.7%		42.9	66.7	0		
covered enough	7		4	1	2		
	58.3%		57.1	33.3	100		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	17	1	4	4	6	2	0
	38.6%	33.3	40.0	30.8	54.5	33.3	0
covered enough	27	2	6	9	5	4	1
	61.4%	66.7	60.0	69.2	45.4	66.7	100
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0
11. Bottom reverberation (irregularities on the ocean floor).							
a. Minesweeper							
not covered enough	3		1	2	0		
	25.0%		14.3	66.7	0		
covered enough	9		6	1	2		
	75.0%		85.7	33.3	100		
covered too much	0		0	0	0		
	0%		0	0	0		

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
b. Submarine							
not covered enough	14	0	4	3	5	2	0
	31.8%	0	40.0	23.1	45.4	33.3	0
covered enough	30	3	6	10	6	4	1
	68.2%	100	60.0	76.9	54.5	66.7	100
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0
12. Environmental conditions affecting absorption loss.							
a. Minesweeper							
not covered enough	5		3	0	2		
	41.7%		42.9	0	100		
covered enough	7		4	3	0		
	58.3%		57.1	100	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	12	0	1	3	5	2	1
	27.3%	0	10.0	23.1	45.4	33.3	100
covered enough	31	3	9	10	5	4	0
	70.4%	100	90.0	76.9	45.4	66.7	0
covered too much	1	0	0	0	1	0	0
	2.3%	0	0	0	9.1	0	0
13. Environmental conditions affecting scattering loss.							
a. Minesweeper							
not covered enough	5		4	0	1		
	41.7%		57.1	0	50.0		
covered enough	7		3	3	1		
	58.3%		42.9	100	50.0		
covered too much	0		0	0	0		
	0%		0	0	0		

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
b. Submarine							
not covered enough	14	0	2	4	5	2	1
	31.8%	0	20.0	30.8	45.4	33.3	100
covered enough	29	3	8	9	5	4	0
	65.9%	100	80.0	69.2	45.4	66.7	0
covered too much	1	0	0	0	1	0	0
	2.3%	0	0	0	9.1	0	0
14. Environmental conditions governing spreading (spherical, cylindrical, dipolar).							
a. Minesweeper							
not covered enough	11		6	3	2		
	91.7%		85.7	100	100		
covered enough	1		1	0	0		
	8.3%		14.3	0	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	18	1	2	5	6	3	1
	40.9%	33.3	20.0	38.5	54.5	50.0	100
covered enough	25	2	8	8	4	3	0
	56.8%	66.7	80.0	61.5	36.4	50.0	0
covered too much	1	0	0	0	1	0	0
	2.3%	0	0	0	9.1	0	0
15. False targets.							
a. Minesweeper							
not covered enough	5		3	1	1		
	41.7%		42.9	33.3	50.0		
covered enough	7		4	2	1		
	58.3%		57.1	66.7	50.0		

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine	*				*		
not covered enough	21	1	7	5	6	2	0
	48.8%	33.3	70.0	38.5	60.0	33.3	0
covered enough	22	2	3	8	4	4	1
	51.2%	66.7	30.0	61.5	40.0	66.7	100
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0
16. Biological noise.							
a. Minesweeper							
not covered enough	4		3	1	0		
	33.3%		42.9	33.3	0		
covered enough	8		4	2	2		
	66.7%		57.1	66.7	100		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine	*				*		
not covered enough	17	0	7	4	4	2	0
	39.5%	0	70.0	30.8	40.0	33.3	0
covered enough	26	3	3	9	6	4	1
	60.5%	100	30.0	69.2	60.0	66.7	100
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0
17. Effects of marine fouling on sound transmission.							
a. Minesweeper							
not covered enough	8		6	0	2		
	66.7%		85.7	0	100		
covered enough	4		1	3	0		
	33.3%		14.3	100	0		

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	26	1	7	6	7	4	1
	59.1%	33.3	70.0	46.2	63.6	66.7	100
covered enough	18	2	3	7	4	2	0
	40.9%	66.7	30.0	53.8	36.4	33.3	0
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0
18. Bottom sediments and acoustic properties of the ocean bottom.							
a. Minesweeper							
not covered enough	6		3	1	2		
	50.0%		42.9	33.3	100		
covered enough	6		4	2	0		
	50.0%		57.1	66.7	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	20	1	3	5	7	3	1
	45.5%	33.3	30.0	38.5	63.6	50.0	100
covered enough	24	2	7	8	4	3	0
	54.5%	66.7	70.0	61.5	36.4	50.0	0
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0
19. Topography of the ocean bottom (bathymetric features).							
a. Minesweeper							
not covered enough	10		6	2	2		
	83.3%		85.7	66.7	100		

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
covered enough	2		1	1	0		
	16.7%		14.3	33.3	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	32	3	9	7	9	3	1
	72.7%	100	90.0	53.8	81.8	50.0	100
covered enough	12	0	1	6	2	3	0
	27.3%	0	10.0	46.2	18.2	50.0	0
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0
20. Locations and general characteristics of the current systems in the oceans.							
a. Minesweeper							
not covered enough	11		6	3	2		
	91.7%		85.7	100	100		
covered enough	1		1	0	0		
	8.3%		14.3	0	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	36	3	10	10	9	3	1
	81.8%	100	100	76.9	81.8	50.0	100
covered enough	8	0	0	3	2	3	0
	18.2%	0	0	23.1	18.2	50.0	0
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
21. Ambient noise (sea surface noise, thermal noise, rain noise, terrestrial noise, etc.).							
a. Minesweeper							
not covered enough	5		2	2	1		
	41.7%		28.6	66.7	50.0		
covered enough	7		5	1	1		
	58.3%		71.4	33.3	50.0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	15	1	3	3	6	1	1
	34.1%	33.3	30.0	23.1	54.5	16.7	100
covered enough	28	2	7	10	4	5	0
	63.6%	66.7	70.0	76.9	36.4	83.3	0
covered too much	1	0	0	0	1	0	0
	2.3%	0	0	0	9.1	0	0
22. Causes of varied salinity conditions in the oceans and areas expected to find these conditions.							
a. Minesweeper							
not covered enough	6		3	2	1		
	50.0%		42.9	66.7	50.0		
covered enough	6		4	1	1		
	50.0%		57.1	33.3	50.0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	27	2	6	8	7	4	0
	61.4%	66.7	60.0	61.5	63.6	66.7	0

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
covered enough	17	1	4	5	4	2	1
	38.6%	33.3	40.0	38.5	36.4	33.3	100
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0
23. Daily and seasonal variations in the temperature conditions.							
a. Minesweeper							
not covered enough	9		6	1	2		
	75.0%		85.7	33.3	100		
covered enough	3		1	2	0		
	25.0%		14.3	66.7	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	24	1	4	7	9	2	1
	54.5%	33.3	40.0	53.8	81.8	33.3	100
covered enough	19	2	6	6	1	4	0
	43.2%	66.7	60.0	46.2	9.1	66.7	0
covered too much	1	0	0	0	1	0	0
	2.3%	0	0	0	9.1	0	0
24. Ray path plotting.							
a. Minesweeper							
not covered enough	11		6	3	2		
	91.7%		85.7	100	100		
covered enough	1		1	0	0		
	8.3%		14.3	0	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	31	2	6	9	8	5	1
	70.5%	66.7	60.0	69.2	72.7	83.3	100

SUBJECT AREAS	TOTAL	E-3	E-4	E-5	E-6	E-7	E-8
covered enough	11	1	3	4	2	1	0
	25.0%	33.3	30.0	30.8	18.2	16.7	0
covered too much	2	0	1	0	1	0	0
	4.5%	0	10.0	0	9.1	0	0
25. Effect of internal waves on sound transmission.							
a. Minesweeper							
not covered enough	11		6	3	2		
	91.7%		85.7	100	100		
covered enough	1		1	0	0		
	8.3%		14.3	0	0		
covered too much	0		0	0	0		
	0%		0	0	0		
b. Submarine							
not covered enough	33	1	8	8	10	5	1
	75.0%	33.3	80.0	61.5	90.9	83.3	100
covered enough	11	2	2	5	1	1	0
	25.0%	66.7	20.0	38.5	9.1	16.7	0
covered too much	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0

*Indicates item was not completed by all respondents.

TABLE IV

AN/SQS-23 AND AN/SQS-26 SONAR TECHNICIAN SURVEY OPINIONS CONCERNING ADEQUACY OF TRAINING RECEIVED IN SUBJECT AREAS.

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
	NUMBER AND PERCENTAGE RESPONDING BY PAYGRADE FOR AN/SQS-23 AND AN/SQS-26 SONAR SHIPS.							
Number Responding								
AN/SQS-23	183	2	20	88	46	17	7	3
AN/SQS-26	145	0	21	40	36	31	13	4
Percent								
AN/SQS-23	100%	1.1	10.9	48.1	25.1	9.3	3.8	1.6
AN/SQS-26	100%	0	14.5	27.6	24.8	21.4	9.0	2.8
1. Temperature effects on the sound velocity profile.								
a. AN/SQS-23								
not covered enough	43	0	2	19	12	7	2	1
	23.5%	0	10.0	21.6	26.1	41.2	28.6	33.3
covered enough	139	2	18	68	34	10	5	2
	75.9%	100	90.0	77.3	73.9	58.8	71.4	66.7
covered too much	1	0	0	1	0	0	0	0
	0.6%	0	0	1.1	0	0	0	0
b. AN/SQS-26								
not covered enough	19	0	1	3	5	8	2	0
	13.1%	0	4.8	7.5	13.9	25.8	15.4	0
covered enough	123	0	20	35	30	23	11	4
	84.8%	0	95.2	87.5	83.3	74.2	84.6	100
covered too much	3	0	0	2	1	0	0	0
	2.1%	0	0	5.0	2.8	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
2. Salinity effects on the sound velocity profile.								
a. AN/SQS-23								
not covered enough	43	0	3	21	10	5	3	1
	23.5%	0	15.0	23.9	21.7	29.4	42.9	33.3
covered enough	138	2	16	67	35	12	4	2
	75.4%	100	80.0	76.1	76.1	70.6	57.1	66.7
covered too much	2	0	1	0	1	0	0	0
	1.1%	0	5.0	0	2.2	0	0	0
b. AN/SQS-26								
not covered enough	28	0	4	5	7	10	2	0
	19.3%	0	19.0	12.5	19.4	32.3	15.4	0
covered enough	112	0	16	33	29	19	11	4
	77.2%	0	76.2	82.5	80.6	61.3	84.6	100
covered too much	5	0	1	2	0	2	0	0
	3.5%	0	4.8	5.0	0	6.4	0	0
3. Pressure effect on the sound velocity profile.								
a. AN/SQS-23								
not covered enough	54	1	5	23	12	9	3	1
	29.5%	50.0	25.0	26.1	26.1	52.9	42.9	33.3
covered enough	128	1	15	65	33	8	4	2
	69.9%	50.0	75.0	73.9	71.7	47.1	57.1	66.7
covered too much	1	0	0	0	1	0	0	0
	0.6%	0	0	0	2.2	0	0	0
b. AN/SQS-26								
not covered enough	28	0	3	6	6	11	2	0
	19.3%	0	14.3	15.0	16.7	35.5	15.4	0
covered enough	114	0	17	32	30	20	11	4
	78.6%	0	81.0	80.0	83.3	64.5	84.6	100
covered too much	3	0	1	2	0	0	0	0
	2.1%	0	4.8	5.0	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
4. Environmental conditions necessary for a surface duct.								
a. AN/SQS-23								
not covered enough	143	2	11	68	37	15	7	3
	78.1%	100	55.0	77.3	80.4	88.2	100	100
covered enough	38	0	8	19	9	2	0	0
	20.8%	0	40.0	21.6	19.6	11.8	0	0
covered too much	2	0	1	1	0	0	0	0
	1.1%	0	5.0	1.1	0	0	0	0
b. AN/SQS-26								
not covered enough	51	0	4	16	11	15	5	0
	35.2%	0	19.0	40.0	30.6	48.4	38.5	0
covered enough	93	0	17	23	25	16	8	4
	64.1%	0	81.0	57.5	69.4	51.6	61.5	100
covered too much	1	0	0	1	0	0	0	0
	0.7%	0	0	2.5	0	0	0	0
5. Environmental conditions necessary for a deep sound channel.								
a. AN/SQS-23								
not covered enough	* 144	2	9	* 69	38	16	7	3
	79.6%	100	45.0	80.2	82.6	94.1	100	100
covered enough	35	0	10	16	8	1	0	0
	19.3%	0	50.0	18.6	17.4	5.9	0	0
covered too much	2	0	1	1	0	0	0	0
	1.1%	0	5.0	1.2	0	0	0	0
b. AN/SQS-26								
not covered enough	70	0	7	19	15	21	7	1
	48.3%	0	33.3	47.5	41.7	67.7	53.8	25.0
covered enough	74	0	14	20	21	10	6	3
	51.0%	0	66.7	50.0	58.3	32.3	46.2	75.0
covered too much	1	0	0	1	0	0	0	0
	0.7%	0	0	2.5	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
6. Convergence zone transmission.								
a. AN/SQS-23	*			*				
not covered enough	128	1	11	56	34	16	7	3
	70.7%	50.0	55.0	65.1	73.9	94.1	100	100
covered enough	52	1	9	29	12	1	0	0
	28.7%	50.0	45.0	33.7	26.1	5.9	0	0
covered too much	1	0	0	1	0	0	0	0
	0.6%	0	1.2	0	0	0	0	0
b. AN/SQS-26								
not covered enough	63	0	5	17	14	18	8	1
	43.4%	0	23.8	42.5	38.9	58.1	61.5	25.0
covered enough	81	0	16	22	22	13	5	3
	55.9%	0	76.2	55.0	61.1	41.9	38.5	75.0
covered too much	1	0	0	1	0	0	0	0
	0.7%	0	2.5	0	0	0	0	0
7. Bottom bounce transmission.								
a. AN/SQS-23	*			*				
not covered enough	128	1	13	56	33	16	7	2
	70.7%	50.0	65.0	65.1	71.7	94.1	100	66.7
covered enough	52	1	7	29	13	1	0	1
	28.7%	50.0	35.0	33.7	28.3	5.9	0	33.3
covered too much	1	0	0	1	0	0	0	0
	0.6%	0	0	1.2	0	0	0	0
b. AN/SQS-26								
not covered enough	62	0	3	15	17	19	7	1
	42.8%	0	14.3	37.5	47.2	61.3	53.8	25.0
covered enough	79	0	17	22	19	12	6	3
	54.5%	0	81.0	55.0	52.8	38.7	46.2	75.0
covered too much	4	0	1	3	0	0	0	0
	2.7%	0	4.8	7.5	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
8. Shallow water sound transmission.								
a. AN/SQS-23	*			*	*			*
not covered enough	100	1	7	48	26	12	5	1
	56.5%	50.0	35.0	56.5	59.1	70.6	71.4	50.0
covered enough	77	1	13	37	18	5	2	1
	43.5%	50.0	65.0	43.5	40.9	29.4	28.6	50.0
covered too much	0	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0	0
b. AN/SQS-26	*		*	*	*	*	*	*
not covered enough	57	0	8	14	15	16	4	0
	42.2%	0	42.1	36.8	44.1	53.3	36.4	0
covered enough	75	0	11	23	18	13	7	3
	55.5%	0	57:9	60.5	52.9	43.3	63.6	100
covered too much	3	0	0	1	1	1	0	0
	2.3%	0	0	2.6	2.9	3.3	0	0
9. Surface reverberation (sea state, wind, and waves).								
a. AN/SQS-23								
not covered enough	61	0	4	26	16	10	4	1
	33.3%	0	20.0	29.5	34.8	58.8	57.1	33.3
covered enough	122	2	16	62	30	7	3	2
	66.7%	100	80.0	70.5	65.2	41.2	42.9	66.7
covered too much	0	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0	0
b. AN/SQS-26								
not covered enough	39	0	4	3	15	14	2	1
	26.9%	0	19.0	7.5	41.7	45.2	15.4	25.0
covered enough	104	0	17	35	21	17	11	3
	71.7%	0	81.0	87.5	58.3	54.8	84.6	75.0
covered too much	2	0	0	2	0	0	0	0
	1.4%	0	0	5.0	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
10. Volume reverberation (including the Deep Scattering Layer).								
a. AN/SQS-23	*			*	*			
not covered enough	77	0	5	35	21	9	4	3
	42.5%	0	25.0	40.2	46.7	52.9	57.1	100
covered enough	104	2	15	52	24	8	3	0
	57.5%	100	75.0	59.8	53.3	47.1	42.9	0
covered too much	0	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0	0
b. AN/SQS-26	*						*	
not covered enough	57	0	4	10	21	16	5	1
	39.6%	0	19.0	25.0	58.3	51.6	41.7	25.0
covered enough	85	0	17	28	15	15	7	3
	59.0%	0	81.0	70.0	41.7	48.4	58.3	75.0
covered too much	2	0	0	2	0	0	0	0
	1.4%	0	0	5.0	0	0	0	0
11. Bottom reverberation (irregularities on the ocean floor).								
a. AN/SQS-23								
not covered enough	74	0	5	34	17	11	4	3
	40.4%	0	25.0	38.6	37.0	64.7	57.1	100
covered enough	109	2	15	54	29	6	3	0
	59.6%	100	75.0	61.4	63.0	35.3	42.9	0
covered too much	0	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0	0
b. AN/SQS-26	*						*	
not covered enough	49	0	5	7	17	15	4	1
	34.0%	0	23.8	17.5	47.2	48.4	33.3	25.0
covered enough	92	0	16	30	19	16	8	3
	63.9%	0	76.2	75.0	52.8	51.6	66.7	75.0
covered too much	3	0	0	3	0	0	0	0
	2.1%	0	0	7.5	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
12. Environmental conditions affecting absorption loss.								
a. AN/SQS-23								
not covered enough	75	0	5	36	20	9	4	1
	41.0%	0	25.0	40.9	43.5	52.9	57.1	33.3
covered enough	107	2	15	51	26	8	3	2
	58.5%	100	75.0	58.0	56.5	47.1	42.9	66.7
covered too much	1	0	0	1	0	0	0	0
	0.5%	0	0	1.1	0	0	0	0
b. AN/SQS-26								
not covered enough	59	0	8	14	15	18	3	1
	40.7%	0	38.1	35.0	41.7	58.1	23.1	25.0
covered enough	85	0	13	25	21	13	10	3
	58.6%	0	61.9	62.5	58.3	41.9	76.9	75.0
covered too much	1	0	0	1	0	0	0	0
	0.7%	0	0	2.5	0	0	0	0
13. Environmental conditions affecting scattering loss.								
a. AN/SQS-23								
not covered enough	71	0	5	32	20	9	4	1
	38.8%	0	25.0	36.4	43.5	52.9	57.1	33.3
covered enough	111	2	15	55	26	8	3	2
	60.7%	100	75.0	62.5	56.5	47.1	42.9	66.7
covered too much	1	0	0	1	0	0	0	0
	0.5%	0	0	1.1	0	0	0	0
b. AN/SQS-26								
not covered enough	49	0	6	11	13	15	3	1
	33.8%	0	28.6	27.5	36.1	48.4	23.1	25.0
covered enough	95	0	15	28	23	16	10	3
	65.5%	0	71.4	70	63.9	51.6	76.9	75.0
covered too much	1	0	0	1	0	0	0	0
	0.7%	0	0	2.5	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
14. Environmental conditions affecting spreading (spherical, cylindrical, dipolar).								
a. AN/SQS-23								
not covered enough	135	2	15	59	38	14	4	3
	73.8%	100	75.0	67.0	82.6	82.4	57.1	100
covered enough	47	0	5	28	8	3	3	0
	25.7%	0	25.0	31.8	17.4	17.6	42.9	0
covered too much	1	0	0	1	0	0	.0	0
	0.5%	0	0	1.1	0	0	0	0
b. AN/SQS-26	*		*					
not covered enough	86	0	11	24	18	21	10	2
	59.7%	0	55.0	60.0	50.0	67.7	76.9	50.0
covered enough	56	0	9	14	18	10	3	2
	38.9%	0	45.0	35.0	50.0	32.3	23.1	50.0
covered too much	2	0	0	2	0	0	0	0
	1.4%	0	0	5.0	0	0	0	0
15. False targets.								
a. AN/SQS-23								
not covered enough	100	0	10	45	24	13	7	1
	54.6%	0	50.0	51.1	52.2	76.5	100	33.3
covered enough	80	2	9	41	22	4	0	2
	43.7%	100	45.0	46.6	47.8	23.5	0	66.7
covered too much	3	0	1	2	0	0	0	0
	1.7%	0	5.0	2.3	0	0	0	0
b. AN/SQS-26								
not covered enough	79	0	8	21	21	20	7	2
	54.5%	0	38.1	52.5	58.3	64.5	53.8	50.0
covered enough	64	0	13	18	14	11	6	2
	44.1%	0	61.9	45.0	38.9	35.5	46.2	50.0
covered too much	2	0	0	1	1	0	0	0
	1.4%	0	0	2.5	2.8	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
16. Biological noise.								
a. AN/SQS-23								
not covered enough	102	0	11	45	25	14	7	0
	55.7%	0	55.0	51.1	54.3	82.4	100	0
covered enough	80	2	8	43	21	3	0	3
	43.7%	100	40.0	48.9	45.7	17.6	0	100
covered too much	1	0	1	0	0	0	0	0
	0.6%	0	5.0	0	0	0	0	0
b. AN/SQS-26								
not covered enough	87	0	11	21	23	24	6	2
	60.0%	0	52.4	52.5	63.9	77.4	46.2	50.0
covered enough	55	0	10	18	11	7	7	2
	37.9%	0	47.6	45.0	30.6	22.6	53.8	50.0
covered too much	3	0	0	1	2	0	0	0
	2.1%	0	0	2.5	5.5	0	0	0
17. Effects of marine fouling on sound transmission.								
a. AN/SQS-23	*		*	*				
not covered enough	115	0	9	53	21	15	7	3
	63.5%	0	47.4	60.9	60.9	83.2	100	100
covered enough	66	2	10	34	18	2	0	0
	36.5%	100	52.6	39.1	39.1	11.8	0	0
covered too much	0	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0	0
b. AN/SQS-26	*			*	*			
not covered enough	102	0	15	24	25	25	10	3
	71.8%	0	71.4	63.2	71.4	80.6	76.9	75.0
covered enough	40	0	6	14	10	6	3	1
	28.2%	0	28.6	36.8	28.6	19.4	23.1	25.0
covered too much	0	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
18. Bottom sediments and acoustic properties of the ocean bottom.								
a. AN/SQS-23	*				*			
not covered enough	117	0	10	56	28	14	6	3
	64.3%	0	50.0	63.6	62.2	82.4	85.7	100
covered enough	63	2	9	31	17	3	1	0
	34.6%	100	45.0	35.2	37.8	17.6	14.3	0
covered too much	2	0	1	1	0	0	0	0
	1.1%	0	5.0	1.1	0	0	0	0
b. AN/SQS-26	*				*	*		
not covered enough	72	0	6	21	17	14	11	3
	50.3%	0	28.6	52.5	48.6	46.7	84.6	75.0
covered enough	71	0	15	19	18	16	2	1
	49.7%	0	71.4	47.5	51.4	53.3	15.4	25.0
covered too much	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
19. Topography of the ocean bottom (bathymetric features).								
a. AN/SQS-23								
not covered enough	135	2	10	66	34	16	4	3
	73.8%	100	50.0	75.0	73.9	94.1	57.1	100
covered enough	47	0	9	22	12	1	3	0
	25.7%	0	45.0	25.0	26.1	5.9	42.9	0
covered too much	1	0	1	0	0	0	0	0
	0.5%	0	5.0	0	0	0	0	0
b. AN/SQS-26								
not covered enough	99	0	11	24	24	27	10	3
	68.3%	0	52.4	60.0	66.7	87.1	76.9	75.0
covered enough	45	0	10	16	11	4	3	1
	31.0%	0	47.6	40.0	30.6	12.9	23.1	25.0
covered too much	1	0	0	0	1	0	0	0
	0.7%	0	0	0	2.8	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
20. Location and general characteristics of the current systems in the oceans.								
a. AN/SQS-23								
not covered enough	146	1	15	72	37	13	5	3
	79.8%	50.0	75.0	81.9	80.4	76.5	71.4	100
covered enough	36	1	4	16	9	4	2	0
	19.7%	50.0	20.0	18.1	19.6	23.5	28.6	0
covered too much	1	0	1	0	0	0	0	0
	0.5%	0	5.0	0	0	0	0	0
b. AN/SQS-26	*				*			
not covered enough	116	0	15	31	29	27	12	2
	80.6%	0	71.4	77.5	82.9	87.1	92.3	50.0
covered enough	26	0	6	9	5	3	1	2
	18.1%	0	28.6	22.5	14.3	9.7	7.7	50.0
covered too much	2	0	0	0	1	1	0	0
	1.3%	0	0	0	2.8	3.2	0	0
21. Ambient noise (sea surface noise, thermal noise, rain noise, terrestrial noise, etc.).								
a. AN/SQS-23								
not covered enough	108	0	8	53	26	12	6	3
	59.0%	0	40.0	60.2	56.5	70.6	85.7	100
covered enough	72	2	10	34	20	5	1	0
	39.3%	100	50.0	38.7	43.5	29.4	14.3	0
covered too much	3	0	2	1	0	0	0	0
	1.7%	0	10.0	1.1	0	0	0	0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
b. AN/SQS-26								
not covered enough	75	0	8	18	20	21	6	2
	51.7%	0	38.1	45.0	55.6	67.7	46.2	50.0
covered enough	68	0	13	21	15	10	7	2
	46.9%	0	61.9	52.5	41.7	32.3	53.8	50.0
covered too much	2	0	0	1	1	0	0	0
	1.4%	0	0	2.5	2.8	0	0	0
22. Causes of varied salinity conditions in the oceans and areas expected to find these conditions.								
a. AN/SQS-23								
not covered enough	125	2	12	61	31	13	3	3
	68.3%	0	60.0	69.3	67.4	76.5	42.9	100
covered enough	57	0	7	27	15	4	4	0
	31.1%	0	35.0	30.7	32.6	23.5	57.1	0
covered too much	1	0	1	0	0	0	0	0
	0.6%	0	5.0	0	0	0	0	0
b. AN/SQS-26	*		*		*			
not covered enough	89	0	7	23	25	24	8	2
	62.2%	0	35.0	57.5	71.4	77.4	61.5	50.0
covered enough	50	0	13	17	9	5	5	1
	35.0%	0	65.0	42.5	25.7	16.1	38.5	25.0
covered too much	4	0	0	0	1	2	0	1
	2.8%	0	0	0	2.9	6.5	0	25.0

SUBJECT AREAS	TOTAL	E-2	E-3	E-4	E-5	E-6	E-7	E-8
23. Daily and seasonal variations in temperature conditions.								
a. AN/SQS-23	*							*
not covered enough	100	1	9	51	26	7	4	2
	54.9%	50.0	45.0	58.0	56.5	41.2	57.1	100
covered enough	82	1	11	37	20	10	3	0
	45.1%	50.0	55.0	42.0	43.5	58.8	42.9	0
covered too much	0	0	0	0	0	0	0	0
	0%	0	0	0	0	0	.0	0
b. AN/SQS-26	*				*			
not covered enough	55	0	7	16	11	14	5	2
	38.2%	0	33.3	40.0	31.4	45.2	38.5	50.0
covered enough	89	0	14	24	24	17	8	2
	61.8%	0	66.7	60.0	68.6	54.8	61.5	50.0
covered too much	0	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0	0
24. Ray path plotting.								
a. AN/SQS-23								
not covered enough	113	2	10	63	23	9	5	1
	61.7%	100	50.0	71.6	50.0	52.9	71.4	33.3
covered enough	58	0	8	20	19	7	2	2
	31.7%	0	40.0	22.7	41.3	41.2	28.6	66.7

covered too much	12	0	2	5	4	1	0	0
	6.6%	0	10.0	5.7	8.7	5.9	0	0
b. AN/SQS-26								
not covered enough	80	0	12	20	18	21	8	1
	55.2%	0	57.1	50.0	50.0	67.7	61.5	25.0
covered enough	50	0	8	13	16	5	5	3
	34.5%	0	38.1	32.5	44.4	16.1	38.5	75.0
covered too much	15	0	1	7	2	5	0	0
	10.3%	0	4.8	17.5	5.6	16.1	0	0
25. Effect of internal waves on sound transmission.								
a. AN/SQS-23	*		*			*		
not covered enough	144	1	13	72	36	14	5	3
	79.6%	50.0	68.4	81.8	78.3	87.5	71.4	100
covered enough	37	1	6	16	10	2	2	0
	20.4%	50.0	31.6	18.2	21.7	12.5	28.6	0
covered too much	0	0	0	0	0	0	0	0
	0%	0	0	0	0	0	0	0
b. AN/SQS-26	*					*		
not covered enough	120	0	14	37	29	25	12	3
	83.3	0	66.7	92.5	80.6	83.3	92.3	75.0
covered enough	23	0	7	3	7	4	1	1
	16.0	0	33.3	7.5	19.4	13.3	7.7	25.0
covered too much	1	0	0	0	0	1	0	0
	0.7	0	0	0	0	3.3	0	0

* Indicates item was not completed by all respondents.

TABLE V

SAMPLE AND POPULATION COMPARISON

Population Strength (15 May 1972: 5,739
Sample Strength: 403
Sample percent of strength: 7.0%

Paygrade	Population 100%	Sample 100%
E-9	1.3	0
E-8	3.9	2.0
E-7	11.2	6.9
E-6	22.5	15.6
STG		
E-5	19.0	22.8
E-4	19.3	34.7
E-3	7.8	11.4*
STS		
E-5	8.9	3.2
E-4	5.4	2.6
E-3	0.7	0.7

*Includes 3 E-2's

ST - 0406	ST - 0434	ST - 0481
0408	0439	0483
0409	0451	0484
0423	0453	0487
0425	0454	0496
0427	0455	
0431	0456	

The average age of the sample was 23.8 years. The average total active military service was 4.8 years. The average civilian education was 12.5 years. The distribution of average age, total active military service, and years civilian education by paygrade is as follows:

Paygrade	Age	Active Military Service	Years Civilian Education
E-8	33.4	15.6	11.5
E-7	31.7	13.6	11.9
E-6	26.7	7.6	12.3
STG			
E-5	23.8	4.5	12.7
E-4	21.7	2.7	12.7
E-3	20.9	1.8	12.8
STS			
E-5	23.8	5.1	12.4
E-4	21.1	2.7	12.1
E-3	21.0	1.6	13.1

In response to the question, "If a voluntary course of programmed instruction in oceanography were available, would you enroll in the course of instruction?", 67 percent replied in the affirmative. For sonar technicians eligible for the Associate Degree Completion Program, approximately 50 percent indicated they would request the ADCOP program if an associate degree in oceanography or as a marine technician was offered.

The sonar technicians were requested to consider 25 subject areas concerning sound propagation and oceanography and indicate whether they believed the subject was covered enough, not enough, or too much in the Navy training schools which they had attended. The list of oceanographic topics should in no manner be considered as all-inclusive. Many important areas were included. Some subject areas were included that sonar technicians are not taught in schools. Responses to these subject areas were intended to serve as an indicator for the reliability of the other responses. The list of 25 subject areas and responses are contained in Tables II, III, and IV.

1. <u>Sonar Technician Comments on Oceanography Training</u>

The personnel surveyed were requested to comment on any suggestions or ideas which they had for increased or decreased training in oceanography. Many responses were received. The responses most applicable to this study have been divided by ship type and are quoted below with the paygrade of the ST submitting the comment. The mine warfare

ST's generally believe the propagation of sound in water was not covered adequately in school nor was the subject of sonar conditions peculiar to mine sweeper sonars. The submarine sonar technician responses indicate that ST's should have at sea experience first and then attend a good course in oceanography taught by a well qualified instructor. The course should be made available in different locations and, additionally, a course should be prepared which could be done while submarines are on patrol. Surface sonar technicians have indicated by their comments that a course in applied oceanography, for career sonarmen, taught by a well qualified instructor or by an oceanographer is desired. They believe there is not enough emphasis being placed on oceanography and conditions in the ocean which affect sonar operations. More oceanography should be contained in classification courses and Class 'A' curricula.

a. Mine Warfare Sonar Technicians Comments

> Propagation of sound in the water was covered too fast in A school (phase I) and was not covered completely due to not enough time. If that school could be lengthened by several weeks, this subject could be covered more fully. E-4
>
> An isolated course in oceanography dealing with the particular sonar used on minecraft and particularly the sonar conditions of operation in short range. E-5
>
> Although oceanography is interesting, sonarmen spend much of their time in maintenance and could use more electronics training. E-5
>
> Oceanography was covered more extensively in the old SOG 31-week sonar A school course. Now with the present A school set up it is hardly touched on as is evident by the trouble SN's and STG3's are having on their tests. I believe it should be covered in more detail. E-6

I would like to see courses tailored for individual equipments as to oceanic environmental effects and how to counter them. For example minehunting sonars have different problems than do ASW sonars. E-6

I've never had any use for knowledge of oceanography. I will say that more training in oceanography would come in handy on exam dates. E-4

b. Submarine Sonar Technicians Comments

More oceanographic training need for proper watchstanding from two areas.
(1) Possibly from a civilian instructor with the knowledge area.
(2) A qualified naval instructor to cover actual usage of knowledge. E-6

Encouragement for completing rate related college and USAFI courses. E-6

No advanced training should be given to anyone who has not been to sea for awhile. Any training in the area of oceanography I feel would greatly enhance a sonarman's know how. E-6

Would like to see a course that is short so people at sea can take time during inport period to attend class. The longer the course the harder it is to get it for sea duty men who will use this information. If the course could be taken in parts its length could be increased. Good basic oceanography studies should include physics of sound, beginning marine science, marine biology, ocean currents and in depth study of operational areas that the sonarman will be in, and have submarine outlook separate, then the surface outlook, followed with aircraft outlook. These would be good places for quick info of sonar conditions of upcoming op areas where sonarmen can go and get what would be the best way to use his sonar and make good sound recommendations for the ops he is to participate in. E-7

The officer course (general oceanography) was good but it didn't cover specific subjects that sonarmen would be interested in (sonarwise). I think a course should be set up about oceanography that covers all aspects having to to with our job. Also maybe a few more courses about oceanography that could be done during patrol. E-5

Establish some courses in oceanography that we could go to. E-6

I believe a good course in oceanography is essential for the career sonar technician but for the one term or six year man would be too costly to benefit the navy. To me this is the prime importance. E-7

I believe more training in oceanography is essential for future prospective ST's. Marine biology and ocean systems are not covered enough in courses of instruction, emphasis is primarily on operating and maintaining equipment. E-4

More attention should be placed on training in oceanography as well as maintenance of equipment. E-5

I feel the curriculum in most navy schools shows a complete coverage of the topic although I believe there is a deficiency in the end product. I feel in a lot of cases the instructor is not familiar enough with the topic to convey the material thoroughly. E-7

Oceanography should be a part of A school. E-4

Need a course just on basic oceanography to understand the different sonar conditions which are encountered from day to day and how they effect sonar ranges either active or passive. E-5

Send all ST's through an oceanographers school, after they're gone to sea and received some on the job training. Make a course available in different areas. E-5

I feel that more information should be given the submarine sonarman on all the effects to be considered when operating active sonar. I feel general training in oceanographic conditions is good, however I feel that more training could be used in the solving of problems dealing with transmission of sound. E-7

General oceanography should be known but not too deeply. E-5

c. Surface ASW Sonar Technicians Comments

Present officer-enlisted naval training courses are not being updated as they should. Any type course in oceanography would be an outstanding idea. Programmed or otherwise. E-7

More schools - a lot of sonarmen would like even a little training in this field. E-5

Before sending personnel to schools in sonar training I suggest that a period of at least six months be made at sea as a striker for sonar. This would give the enlistee a chance to get to know his oceanography and other related areas. E-5

Too little oceanography to have a good idea of what is really going on under water. The greatest source is target classification and it is too short. E-5

More tape recordings of identified non sub contacts and sub contacts. E-5

People need much more extensive training on figuring ray path plots and breakdown of SHARPS. E-3

Get an oceanographer to teach oceanography. E-3

A better knowledge of oceanography would be beneficial to all personnel concerned with ASW operations, officer and enlisted. E-7

Oceanography should be covered more in "A" school to give students a better understanding of the subject. E-4

The basics of oceanography are all that's needed unless specializing in that field. E-6

There should be any type of training in oceanography for enlisted personnel to better acquaint them with the oceans' environment. E-5

The sonar technician should have a good basic understanding of environmental conditions that affect propagation of sound in sea water. E-5

More detailed instruction on medium properties and the areas that affect sound transmission in that medium. E-6

Characteristics of sound transmission with regard to different ocean areas. E-5

In my opinion there is not enough emphasis on oceanography and its effects concerning sonar operations. Classification would be greatly improved with increased knowledge of oceanography. E-7

A one week training class in oceanography set up at the various bases on both coasts. A training class in range prediction including ray path plotting. E-5

Special classes convened for ray path plotting. E-4

I think that personnel should be told about it upon entrance into boot camp and steps taken to give a basic course on oceanography while in boot camp. E-4

One week fleet schools for oceanography and other sonar related subjects should be established for sonarmen during inport periods. E-5

To have an efficient ASW force they must be well trained. To achieve this the schools should be complete in every aspect of ASW. In ASW you need every edge or advantage which includes every bit of knowledge possible. E-5

I would like more knowledge of the oceans and sonar's operation in them. E-4

More information on bottom effects and layer depths. E-4

The only training I have obtained is thru correspondence courses. Any of the material covered by a course not already used in training would be beneficial. E-5

Oceanography is a complicated subject and requires intense study to gain any serious benefit. It would seem unnecessary to train sonar technicians to any degree other than the explanation of sound propagation. E-5

Why not set up a consensed course of 4 or 5 weeks duration for 2nd class and above from fleet only which deals only with oceanography as the sonarman is concerned with it. E-6

Mainly no one really cares whether or not the man understands the information as long as he remembers it for a test. E-6

A short course of instruction (4-6 weeks) should be made available to all petty officers as an introduction to oceanography. E-6

Produce some good movies explaining sound propagation and the fundamentals of oceanography. E-6

I sincerely believe that each sonar technician should be exposed to a basic oceanography course, in the very least. E-4

Greater emphasis placed on oceanography in existing Class "A" schools, and development of a Class "C" school to be attended by existing sonar technicians. E-6

Sonar classification school (2 weeks) was the most comprehensive refresher course I've attended. This course should be made available to everyone in sonar at least twice a year. E-4

A course similar to the classification school in oceanography would be very beneficial. E-4

Usually after graduating from Class A, B or C schools anything that was learned about oceanography is either forgotten or vaguely remembered simply because we do not come in contact often in practical use. E-4

I would like to see more "Physics of sound in water" taught in "A" school. Also a Navy type quarterly or monthly for sonarmen containing updates on operating techniques and informative data in physics of sound. E-5

Professionalism can only be accomplished through more education and application of marine elements in the ST rating. E-6

Would like to see classification courses expanded to include more oceanography. E-6

Should be put into more than just a portion of a week classification course and should be made available in more places than the 2 FLTASWSCHOL locations. A refresher course should be made available in WESTPAC/EASTPAC areas, shortened, and inclusive of area peculiarities. Should be made an integral part of school and referred to often - not just "test and forget." Fleet program of usage definitely needed to combat "learn at school, forget for the fleet." E-6

I would like to see more oceanography included in our training. E-6

More of an oceanography program in "A" school. E-5

More schooling can do nothing but aid the sonar technician and better prepare him for the problems he will face at sea. E-3

The oceanography courses I have completed were very interesting to me, however if I wish to go farther with oceanography I would have to enroll in USAFI courses. I have tried USAFI before and I don't care for their courses. E-8

If a course could be set up to cover more on the subject of oceanography, I feel it would be beneficial to all sonarmen. What little we are taught today is completely inadequate. E-5

The training and education in oceanography is of the bare minimum. ST's definitely need a lot more training of the various water conditions and the effects the ocean has on sound. E-5

Give sonar operators a thorough background in the environmental characteristics of the medium in which we operate the equipment. E-7

At the moment, very little oceanography is available to surface ST's, suggest a course be made available to ST's prior to an operator's school. E-7

They should start a course dealing in all phases of oceanography pertaining to sonar. E-7

Most of the above subjects [on the survey form] are learned mostly under actual sea operation. It is difficult to retain instruction of this type unless it can be heard and analyzed either at sea or possibly good tapes. E-6

Seminars or workshops should be started to increase interest in oceanography and sound propagation. Sonar needs to be a good thing again. E-5

More education for non-sonarmen on sonar characteristics and limitations. E-5

An ST should have a deeper understanding of oceanography than he has. The subject is not stressed - possibly due to a lack of instructor understanding. The material that is presented is often confused. Better instructor training in this subject would be a definite help. E-4

Ray path theory, although not much used in todays predictions; its beneficial in understanding the path of sound through water. E-5

Add an extra week or so of oceanography to the "A" school curriculum. E-5

Better study in the effects of thermal gradients on sound propagation. E-5

I would like to see the development of a 6 to 8 week course in oceanography and the relation of oceanography to the Navy's major sonar systems, mandatory for PO2 and above. E-6

I think oceanographic training would enhance our ST's to understand not only what our operating parameters are, but why. E-6

I think more time should be devoted to oceanography in A school, and a little less to electronic theory. E-6

The fleet needs more training in oceanography. Many people come out of school to the fleet very confused and unsure of what and why sound does what in water. E-6

More training in oceanography would probably aid in operating the sonar effectively. E-5

I don't believe sonarmen need that extensive amount of oceanographic education to become efficient in their rate. E-6

There was definitely not enough training in 'Al' school on all environmental effects of sound in water especially pertaining to a particular sonar system. E-6

The use of programmed instruction would seem to implement the further education and continuing education of a well informed sonar team. E-4

A course, either programmed or formal, which could be administered as refresher training for operators, stressing the effects of the various operational controls on overcoming the effects of environmental conditions. E-7

I think a refresher course after about 1 year on duty station would be good, especially on oceanography and sound transmission and classification procedures. E-4

I believe that if at all possible they should have a separate course in oceanography to afford a better understanding of ocean environment to the fleet sonarman. E-6

A course such as USAFI offers would beneficially improve an ST's knowledge in oceanography, on top of the Navy's training course which offers the bare essentials for dealing with the ocean. E-5

At present there are too many publications on this subject in my opinion. Some of these manuals are even contradictory. I think that it would be beneficial to condense all this info into one oceanographic "bible." As new data is obtained, simply make changes to this book. E-7

I personally believe that there should be more training in oceanography. I know that I would be a better operator if I fully understood the conditions that affect sound transmissions. E-4

Not necessarily more time is necessary to cover the subject of oceanography, but we need higher caliber instructors. E-4

Officers as well as enlisted personnel working with sonar should be made to take courses in oceanography so they may work better together. E-4

I feel that much more time should be spent on training personnel, both enlisted and officer (ASW and ASW connected), on environmental and biological conditions that effect the promulgation of sound through water. This field is not covered sufficiently in sonar 'A' schools. E-6

2. Sonar Technician Comments Concerning Other Training

The personnel surveyed were requested to list any subject areas not included in the survey which they felt should be included in Navy training schools that would enhance their performance of assigned duties. The responses which are pertinent have been separated into the ship type and are quoted below with the paygrade of the ST submitting the comment.

Minesweeper sonar technicians believe they should have more training in electronics and in classification. Submarine ST responses have indicated that more basic electronics and mathematics training and instruction would benefit them in the performance of their duties. Surface sonar technicians have shown by their comments that more training in the use, interpretation, effectiveness, and reliability of SHARPS is the subject area which would most improve their performance of duties. They believe that there should be an "at sea" phase in class A school. The lack of practical training in equipment maintenance, repair, and trouble-shooting was commented on by the ST's. Passive sonar training is also considered necessary in their training.

a. Mine Warfare Sonar Technicians Comments

Although oceanography is interesting sonarmen spend much of their time in maintenance and could use more electronics training. E-5

I definitely feel ST's are undertrained for their expectation requirements. We have very little training in electronics (Even to the extent of safety hazards) E-4

More practice with classification and tracking. E-5

More attention should be given to how oceanographic effects look, why they are caused, and how to deal with them when working a contact. E-6

b. Submarine Sonar Technicians Comments

Practical application is the best instruction. E-6

In my experience I have found it is a lot easier to mold a good operator than a good maintenance man. I find most personnel are lacking the basics of electronics which makes it very difficult to train on the equipment levels. E-7

Own ship's noise monitoring. E-6

Mathematics. E-6

More electronics knowledge requirements for advancement to E-4 and E-5. E-7

c. Surface ASW Sonar Technicians Comments

I believe that to enhance a sonarman's performance, it would be advantageous for him to go through about a week sea phase in order to show him the importance and the time in which he will use his new found knowledge and take more pride in his learning. E-5

More time should be spent on the different type sonar systems. In my "A" school calss we only operated a mock-up of the SQS-4. E-4

Echo or target discrimination between various marine life, bottom topography, etc vs. actual targets. E-2

Interpretation of sonar PPI presentations. F-6

At present there are several methods of determining what happens to transmitted sound in water. Namely TACRAPS, SHARPS, and ray path plotting. It has been my experience that the results of the various methods do not agree. It would be appreciated by the majority of sonarmen if someone could develop an accurate standard of prediction. E-5

Not enough study of sound propagation in school. E-4

Lack of labs and personal instruction. E-4

I believe there is too small an amount of training in both operations and maintenance. E-4

All topics concerning sound and what effects it. Officers (PCO, PXO and PASWO) should receive training in oceanography. E-7

Practical usage and theory of operation of test equipment in all sonar maintenance checks. E-7

More trainer time per person. E-3

Training should include more about the characteristics of unfriendly or foreign technology and warfare. E-5

More emphasis on passive sonar operation. Maybe some courses in sub sonar. E-3

Submarine maneuvers and capabilities. E-4

Listening to different submarines in different environments. E-5

A large number of good quality sonar tapes to allow students to get practical experience on sonar gear. E-4

Some accurate method of range prediction - the system is changed too much. E-6

Schematic reading. E-5

SHARPS BT interpretation. E-6

Ship's self noise effects. E-6

Teach students the whole system (dome, fathometer, UQC). E-5

Effects of currents on sound transmission and returning echos. E-4

SHARPS - updating of material - keep up with the fleet. E-4

For my present work I need electronics more than oceanography. E-5

Less training on outdated gear, i.e., the old BT system, more training on the XBT. E-4

Additional exposure to the active and passive sonar equations and its relationship to source level measurements. E-4

How to fill out bathy messages/sea surface temperature log. XBT trace reading and conversion to log. More "SHARPS" info should be put out. E-4

TACRAPS/SHARPS II. E-6

A good basic instruction for "A" school, and a required refresher training period once a year. E-

More training on the equipment, instead of just book training. E-4

Go to sea duty first before going to school. E-4

Use more tapes with non sub contacts. E-4

While at school be able to be aboard ship for a couple of weeks to compare with what you have learned, actual sea conditions. E-3

More time should be spent on repair and trouble shooting in "A" school. E-3

I believe there should be a refresher course for those who go through 'A-2' and 'C' after having your mind crammed with more information and not using what you were taught in 'A-1'. E-4

Much more training in stack operation and electronics. E-4

SHARPS, ASRAP. E-8

Maintenance of sonar sub systems, UQN, UQC, TRR, and XBT. Instruction in SHARPS. E-5

Passive reception. E-5

Instruction on reading and using SHARPS. E-4

Layer effect. E-6

Audio-visual analysis of environmental conditions, marine life. Contact recognition analysis, inclusive of ship type characteristics. E-7

A little better training course for "C" schools such as the 26 BX sonar maintenance course, by getting the technicians a little more prepared for the problems he will probably encounter when at sea and a lot more lab time with the gear. E-4

Place emphasis on the structure of water layers and sound tracks. E-6

More tactical training in ray path plotting. E-6

Actual operation of BT recorder, and fathometer. Become more familiar with PMS functions. E-3

Higher quality instructors. E-7

More ping time on actual subs. E-5

Under the present school setup, no sea phase is given. It is impossible to train an operator in a lab and prepare him for sea conditions. E-7

More tapes and movies to show actual at sea experience on sound transmissions. E-4

An on board operators course lasting at least a week at sea before assignment. E-4

Mutual interference. E-5

Procedures for source levels, receiver sensitivities, noise levels, performance figures. E-8

Better system operator training on all types of attacks. E-6

More training in passive sonar watch standing. E-6

Passive sonar contact identification. E-5

Use, effectiveness, and reliability of SHARPS. E-4

I feel that much of my time was wasted in training on sonar systems that were obsolete. E-3

B. SHIP EXECUTIVE OFFICER SURVEY

In addition to the sonar technician survey forms, a questionnaire was distributed to the executive officers of the 76 randomly selected ASW surface ships, submarines and mine warfare ships. The purpose of this form was to obtain the opinion of executive officers concerning the topics which should be included in a training program for ST's to meet their needs for interpreting the ocean environment and its relationship to ASW or mine warfare. The questionnaire also requested the opinion of these officers on <u>any</u> significant deficiencies in the training of ST's, and further requested

an opinion of which other ratings, if any, should receive training in oceanography. Many interesting responses were received. The responses have been separated according to ship type and are presented in the following sub-sections.

1. <u>Mine Warfare</u>

The consensus is that training received by the mine-warfare sonar technicians is inadequate in the areas of applied oceanography. They also believe OT's, QM's and RD's should receive training in oceanography in addition to ST's. Several state the training in the maintenance of sonar equipment is deficient. More casualty, trouble-shooting analysis, and circuit reading skills are needed for a new man to be a capable fleet ST. There is too much of an emphasis on hardware, making the ST's nothing more than repairmen rather than the overall experts they should be. Anyone responsible for the operation of or planning for any use of an underwater weapon system, location detector, or countermeasures system should be thoroughly familiar with oceanography in relation to the equipment he is concerned with. The following is a compilation of topics the officers believe should be included in the ST training.

a. SHARPS interpretation

b. salinity, temperature, and pressure effects

c. tides and currents

d. bottom types

e. biological factors affecting mines

f. ray path plotting

g. convergence zone phenomenon

h. propagation losses

i. H.O. - 765

j. introduction to hydrographic/oceanographic data

k. introduction to mine warfare pilots

l. near-shore bathymetry in relation to:

(1) mine burial

(2) mine scouring

(3) mine movement

m. bottom bounce sonar back scattering phenomenon

n. effects of environmental parameters

2. <u>Submarines</u>

The consensus is that training received by the submarine ST is inadequate in the areas of applied oceanography. One noteworthy response stated: "The training received appears to be adequate if the sonar technicians take advantage of correspondence courses and other refresher courses which are available to them. The timing (or sequence) of the receipt of oceanographic information could be improved upon. Sonar technicians should receive a sufficient introduction to oceanography to have a base on which they can build an adequate knowledge. An in-depth knowledge should be provided after they have had some at-sea experience."

In addition to ST's, the executive officers believe QM's and other rates that become involved in operational planning of exercises involving ASW units should receive training in oceanography. The most significant deficiency

in training is considered to be in the area of practical training. Too much time is spent learning from a book instead of learning to make actual repairs and adjustments. Following is a compilation of topics the officers believe should be included in the submarine ST training.

a. ray path plotting

b. ocean current systems

c. acoustic properties of the ocean bottom

d. marine biology

e. topography of the ocean bottom

f. causes of daily, weekly, and monthly changes in the environment

g. how environmental changes affect sound propagation

h. techniques for calculating sound propagation paths (and variations) using installed equipment

i. sources of practical information on the ocean environment, where this information is available, and how to use it in an operational situation

j. how to integrate the information provided (or available) from shipboard sensors with that information which can only be found in publications.

3. Surface ASW Ships

The consensus, by a ratio of three to one, is that training received by the sonar technicians is inadequate in the areas of applied oceanography. The officers believe the other rates which should receive training in oceanography are OT, QM, TM, AX, RD, AG, and AW. The greater response

from the ASW surface ships allowed for more variation in opinions. The following is a list of deficiencies which are considered to be significant in the training of sonar technicians.

a. The lack of submarine services for actual shipboard ASW training.

b. Training in the operation of the AN/SQS-26 sonar.

c. The great majority of STG's do not have a good understanding of submarine capabilities and limitations, such as, surface ship counter-detection ranges and evasive maneuvers.

d. School training devices are limited and old. There is a lack of practical laboratory training in schools.

e. There should be more use made of classification courses, perhaps the course should be made a mandatory quarterly or semi-annual refresher.

f. Emphasis on the importance and use of PMS.

g. Leading petty officers need updating on new methods and new knowledge gained in the field of oceanography.

h. The sonar equipment has become so complex that we tend to teach mechanics instead of an overall package in ASW.

i. Basic electronics, theory/practical experience in maintenance and trouble-shooting techniques. Equipment, trouble-shooting, and repair ability is limited by insufficient theory in the training background of most ST's.

j. More stress on the best techniques in operation and tactical use of the sonar is necessary. ST's lack much

practical experience because of extremely limited submarine services.

In regards to the oceanographic topics which should be required for sonar technician training, the compilation as determined from the survey of executive officers of ASW surface ships is given below.

a. marine biology and biological scattering.

b. ray paths and ray path theory.

c. self-noise and background noise.

d. underwater sound propagation losses.

e. bottom topography.

f. environmental support services available.

g. sonar range prediction techniques - SHARPS.

h. diurnal and seasonal changes of the thermocline.

i. effects of currents.

j. effects of temperature, pressure, and salinity on the sound propagation from all types of sonars.

k. locations and conditions necessary for deep sound channels, convergence zones, and surface ducts.

l. submarine evasive tactics.

m. sound propagation in and characteristics of different areas of the oceans.

n. cause and effects of false contacts.

o. deep and shallow water sound transmission.

p. effects of wind on the sea surface.

q. reading and interpreting bathythermograph traces, and SHARPS, and ASRAP messages.

r. the methods of predicting detection ranges and the reliability of these methods.

s. effects of reverberation, ambient noise, and scattering.

t. instruction on the ST's particular sonar system in various environmental conditions.

u. instruction in the proper use of commonly available publications for sonar work.

v. bottom bounce transmission.

w. increased use of Performance Monitoring Equipment (PME) tapes to illustrate effects of various environmental factors and for operator training.

Several of the comments by the ASW surface ship executive officers concerning the inadequacy of applied oceanography training are very pertinent to the study and are quoted herein.

> ASW is conducted in the ocean-yet those men with the most expertise know very little except by their own experience and outside endeavor to learn. XO, AN/SQS-26 sonar ship

> I do not feel that any other ratings on board ship require training in oceanography for the purposes of ASW. However, there is much need in the officer area, particularly the senior officer area, so that there is a better understanding of the problems of layers, detection ranges etc. This would help considerably to reduce the "frustration" of the ST's who continually face the questions from higher authority who draw the conclusion that it is the equipment and not the water conditions when contact cannot be gained or held at the same range we held it a few hours ago or yesterday. XO, AN/SQS-26 sonar ship

> It is obvious from the survey aboard USS ____________ that the majority of sonarmen feel that the Navy training schools are inadequate preparation for their job requirements. It is my opinion that sonarmen receive only enough training in applied oceanography to whet their appetites

and/or frustrate them. Training should emphasize the effects of environmental conditions on sound propagation patterns rather than the "why" or causes of these existing environmental conditions. There is a demanding need for more formal training in the concepts of applied oceanography, for, only through a thorough understanding of the complexities of environmental conditions can sonarmen make accurate predictions concerning expected sonar conditions, tactics to be employed to detect submarines, and expected tactics utilized by submarines to avoid detection. XO, AN/SQS-23 sonar ship

The average sonar technician does not understand the domain he is working in, at least not to the degree necessary to fully utilize the capabilities of todays equipment. XO, AN/SQS-29 sonar ship

Even if they do go through formal training in it, very few seem to apply it when underway. XO, AN/SQS-23 sonar ship

The basic knowledge of range prediction is the only training that a large majority of the sonar technicians have. To fully understand the ocean environment, just as an experienced hunter is adept on land, they should be fully aware of the aspects of oceanography. XO, AN/SQS-23 sonar ship

Most of the sonar technicians surveyed felt that more emphasis could be placed on all areas covered in item 15 (25 oceanographic topics) of the questionnaire. XO, AN/SQS-23 sonar ship

Training now being received by ST's in areas of applied oceanography is barely adequate. Sonarmen know how to fill out forms to derive needed information but lack background understanding of the principles they are applying. XO, AN/SQS-26 sonar ship

The oceanic environment controls the efforts of the ST's and a thorough understanding of at least the basics of the physics of sound in water is essential to intelligent performance of the ST's duties. XO, AN/SQS-26 sonar ship

I obviously do not feel the training now provided a surface sonarman is adequate. I do not feel there is enough emphasis or appreciation about the oceanic environment. XO, AN/SQS-23 sonar ship

The ignorance of the surface community officer corps in general oceanographic/sonar considerations make the majority of our enlisted training efforts a total waste of time and money. XO, AN/SQS-23 sonar ship

Most (ST's) do not even think about ocean conditions.
XO, AN/SQS-23 sonar ship

C. AVIATION EXECUTIVE OFFICER SURVEY

A questionnaire was mailed to the executive officers of a combination of 26 randomly selected Helicopter Antisubmarine Squadrons (HS), Air Antisubmarine Squadrons (VS), and Patrol Squadrons (VP). The purpose of this survey was to ascertain the adequacy of oceanography oriented training and education for enlisted men involved in airborne ASW. Responses were received from 50% (13/26) of the squadrons surveyed. Several of the executive officer comments were supplemented by air-crewmen comments. The responses by squadron type were as follows:

HS	3/5	-	60%
VS	5/7	-	71%
VP	5/14	-	36%

The officers were requested to list the Group IX aviation ratings which they believed should receive training in oceanography. The result of this survey question, in order of priority, was AW, AG, AX, AT, and TD. The AX, AT, and TD listings were few in number, of a lower priority, and were received from the HS and VS squadrons. An opinion was requested of the adequacy of formal school training received by airborne ASW personnel in the areas of applied oceanography. Overall nine of thirteen responses considered the present training to be adequate; one of the three HS, three of five VP, and five of five VS. However, only two of thirteen

replies considered the formal school training received by airborne ASW personnel to overemphasize the oceanic environment and its relationship to ASW. Both affirmative replies were from VS squadrons.

The aviation squadron executive officers were requested to list topics which should be involved in an academic program to meet the specific needs of enlisted men requiring training in interpreting the oceanic environment and its relationship to ASW. The consensus compilation follows:

1. Environmental services (ASRAP, SHARPS)
2. Features of the ocean bottom (geology, composition, bathymetry)
3. Temperature, pressure, salinity effects on the sound velocity profile
4. Oceanic heat budget and factors relating to its balance
5. Variations in water temperature (three layered ocean)
6. Air/ocean environment (winds, waves, currents)
7. Physics of underwater sound propagation
8. Transmission losses (spreading, absorption, scattering)
9. Sound transmission paths (direct, bottom bounce, surface duct, sound channels, convergence zone)
10. Ambient noise (biologics, sea state, traffic noise, DSL)
11. Passive sonar equation and aspects
12. Sound intensity measurement (decibels, source level)
13. False targets

14. Ray path plotting

15. Physical and chemical properties of seawater

16. Tactical applications related to the type equipment being operated.

The survey responses contained several interesting comments which are pertinent to this study. These comments generally convey the idea that the enlisted training currently available is adequate with much praise being given to FASOTRAGRULANT and PAC training courses. However, the main problem is the lack of scheduled refresher training or review, preferably annually, to augment the previous training in oceanography. These comments are quoted below.

> Yes, although the majority of tactical coordinators do not demand the high level of proficient use of applied oceanography of which the average AW is capable. (In reply to question concerning adequacy of training.) AWC, VP

> Far more emphasis and depth should be placed on oceanography in AW (A) school. CDR, HS

> It is felt that there should be more done in the area of refresher training in oceanography after the AW is designated. LT, HS

> The subject matter cover is sufficient, though a more formal review on an annual basis would be recommended. LTjg, VS

> The general attitude is that the AW's presently know as much oceanography as is necessary for them to perform their duties. The present basic oceanography in "A" school is meaningful. However, the AW's are given better courses in FASOTRAGRULANT and again in VP-30 (CRVP). CDR, VP

> In recent years the oceanography training at the formal school level has made great strides forward. The problem that exists at this point in time is two fold. 1. Setting up refresher training annually at the squadron level or better yet at the FASOTRAGRUPAC level. Secondly, the more senior people who haven't been through a formal school in the last 5 years will need additional training over and

above refresher training to update them on current techniques and procedures. LT, HS

An academic program of oceanography has been developed within the squadron. However, due to the complete presentation by FASOTRAGRUPAC of acoustic properties of sea, sonar equations, probabilities, non-acoustic environment and affects on tactics, our program requirements are only for ASWEPS data and rating exam material. CDR, VS

The main topic of any academic program should be sound propagation. Understanding sound propagation in water is the central problem of all ASW. Currently it is dealt with at a very elementary level in all training given to fleet replacement personnel. This training gives operators a basic understanding of various sound transmission phenomena, but does not give them anything that aids in the evaluation of sensor data. CDR, VP

In todays era of the ever quiet running submarine, there can't be enough emphasis on ocean environment and its relationship to ASW. CDR, VP

Even the greatest scientists claim the sea is a mystery, and our training is just a pure and simple minimum in my opinion. I feel the first hurdle to be jumped is to get better men to teach the subject, not just officers and enlisted men with fleet experience, but a professional oceanographer. Then make the schools much more comprehensive than they presently are now. CDR, VP

Oceanography has been stressed to a great degree but only at certain instances in time of an enlisted man's career. Generally, when a person enters the service, attend. "A" school and enters a field involved with ASW, particularly the AW rate, he has a great deal of material concerning oceanography thrown at him. After this initial introduction there isn't much of a continuing program to augment his training in this field. AW 1, VS

A knowledge of overall oceanography is essential to allow him (AW) to understand the reasons for his sensors differing performance, but I don't feel greater training would allow him to obtain greater performance. LT, VS

Historically, the formal school training for AW's has been inadequate, however I think the problem has been recognized. The AW "A" school needs to teach more "operator" training rather than present electronic "maintenance oriented" training. CDR, VP

I think we in the VP community have identified our shortcomings in the oceanography field and are on the right track now toward a solution. CDR, VP

APPENDIX E

RATE TRAINING MANUALS, STUDY GUIDES, AND CORRESPONDENCE COURSES

Section III includes information concerning the oceanography, underwater sound theory, and oceanography-related training topics which are a portion of the study material contained in the rate training manuals for the AG, AW, OT, QM, RD, and ST ratings. A listing of the rate training manuals, study guides, and correspondence courses for the ten ratings identified in Section II as requiring training in oceanography is provided in this appendix. Additionally, applicable officer correspondence courses and subject training manuals are included. The rate training manuals and correspondence courses are identified by NAVPERS (Bureau of Naval Personnel) and NAVTRA (Naval Training) numbers [38].

A. MILITARY TRAINING

Rate and Rating	Rate Training Manual	Correspondence Course
MRPO 3 & 2	10056-C	91206-1
MRPO 1 & C	10057-C	91207-G
MRPO E-8/9	10115	91209

B. OCCUPATIONAL TRAINING

Rate and Rating	Rate Training Manual	Correspondence Course
AG 3 & 2	10363-C	91664-2A
AG 1 & C	10362-A	91603-1A
AW 3 & 2	10350 (c)	91688 (c)
AW 1 & C	10351 (c)	91552 (c)

Rate and Rating	Rate Training Manual	Correspondence Course
AX 3 & 2	10353-B (c)	91577-C (c)
AX 1 & C	10354-B (c)	91697-B (c)
MN 3 & 2	10166-A (c)	91335-2C (c)
MN 1 & 2	10167-A (c)	91337-2C (c)
OT	Study Guide for OT SP 10026-D	none
QM 3 & 2	10149-D	91286-2C
QM 1 & C	10151-C	91253-E
RD 3 & 2	10144-A (c)	91269-1B (c)
RD 1 & C	10147-D (c)	91268-1 (c)
STG 3 & 2	10131-B (c)	91261-1C (c)
STS 3 & 2	10132-A (c)	91259-4 (c)
ST 1 & C	10140-D (c)	91265-1 (c)
TD 3 & 2	10376-C	91698-1B
TD 1 & C	10378-C	91699-D
TM 3 & 2	10163-B (c)	91297-E (c)
TM 1 & C	10164 (c)	91299-1 (c)
	Study Guide for TM SP 10082	

C. OFFICER COURSES

Course Title	Course Number	Textbook
GENERAL OCEANOGRAPHY	NAVTRA 10417-A	Exploring the Ocean World by C. P. Idyll Editor
OCEANOGRAPHY IN ANTISUBMARINE WARFARE (course obsolete and discontinued, July 1972)	NAVPERS 10418 (c)	H. O. 781 (c)

Note: Classified rate training manuals and correspondence courses identified by (c).

APPENDIX F

TRAINING SCHOOLS AND COURSES

Section III includes a brief synopsis of the oceanography, underwater sound theory, and oceanography related training subject matter which is included in Navy training schools and courses for the AG, AW, OT, QM, RD, and ST ratings. A listing of schools and courses by course identifying number, course title, and location is included in this appendix. The course identifying numbers are preceded by a letter designating the command producing and publishing individual school and course catalogs for training conducted by their activities. Commands offering the courses listed in this appendix are identified as follows:

A Bureau of Naval Personnel

C Naval Air Training Command

H Amphibious Force, Pacific

J Training Command, Atlantic

K Training Command, Pacific

The course identifying numbers consist of six to eight characters identifying the command sponsoring the course, the skill for which the course trains, and a sequential number to facilitate locating the course within the catalog. The skill code is the Department of Defense skill identifying code. This code consists of three digits for enlisted personnel. The sequential number is determined by the number

of courses listed under the same DOD skill identifying code. In certain instances, one or more catalog producing commands list courses in their catalog which are duplicate listings. The courses for the subject six ratings are listed in Table VI and include the duplicate numbers [39, 40, 41, 42, 43].

TABLE VI

REPRESENTATIVE LIST OF TRAINING SCHOOLS AND COURSES

Course Identifying Number	Course Title	Location
C - 420 - 2010	Aerographer's Mate Class A	NATTC Lakehurst, N.J.
C - 420 - 2011	Aerographer's Mate Class B	NATTC Lakehurst, N.J.
C - 420 - 2012	Air - Ocean Environment Course, Class C	NATTC Lakehurst, N.J.
C - 210 - 2010	Aviation Antisubmarine Warfare Operator, Class A	NATTC Millington, Tenn
A - 210 - 0011 J - 130 - 0555	Ocean Systems Technician, Class A	Fleet Sonar School Key West, Florida
J - 772 - 6201	Quartermaster Course	FTC Newport, R. I.
K - 772 - 600	Basic Quartermaster	FTC San Diego, Calif.
K - 772 - 601	Piloting and Publications	FTC San Diego, Calif.
A - 221 - 0011	Radarman Class A	SSC Great Lakes, Ill.
A - 221 - 0015	Operations Specialist	FAAWTC San Diego, Calif.
A - 130 - 0014	AN/SQQ - 14 Operator/Maintenance	Mine Warfare School Charleston, S.C.
A - 130 - 0020	Submarine Sonar Subjective Analysis	Submarine Base, New London, Conn.
A - 130 - 0028 J - 130 - 0545	General Submarine Sonar Maintenance	FSS Key West, Florida
A - 130 - 0029 J - 130 - 0515	Sonar Technician Class A - 1 (Submarine)	FSS Key West, Florida

A - 130 - 0030 K - 130 - 1007	Sonar Technician Class A - 1 (Submarine)	FLEASWSCOL San Diego, Calif.
A - 130 - 0032	Submarine Sonar Subjective Analysis	NAVSUBTRA FAC Pearl Harbor, Ha.
A - 130 - 0033	Submarine Sonar Subjective Analysis	FBM Training Center Charleston, S.C.
A - 130 - 0037 K - 130 - 1029	Sonar Technician Class A - 1 (Surface)	FLEASWSCOL San Diego, Calif.
A - 130 - 0038 J - 130 - 0505	Sonar Technician Class A - 1 (Surface)	FSS Key West, Florida
A - 130 - 0046 K - 130 - 581	Sonar AN/SQS-26BX Maintenance	FLEASWSCOL San Diego, Calif.
A - 130 - 0047 J - 130 - 0865	Sonar AN/SQS-26CX Maintenance	FSS Key West, Florida
A - 130 - 0048 K - 130 - 585	Sonar AN/SQS-26CX Maintenance	FLEASWSCOL San Diego, Calif.
A - 130 - 0069 K - 130 - 1023	Sonar AN/SQS-35(V) Maintenance	FLEASWSCOL San Diego, Calif.
A - 130 - 0070 J - 130 - 0685	Sonar AN/SQS-35(V) Maintenance	FSS Key West, Florida
A - 130 - 0072	UQS - 1 Operator/ Maintenance	Mine Warfare School Charleston, S.C.
A - 130 - 0077 J - 130 - 0665	Advanced ASW Systems Technology	FSS Key West, Florida
J - 130 - 087	Sonar (AN/SQS-26 AX(R) and CX) Operations	FSS Key West, Florida
J - 210 - 502	Bathythermograph Operations	FTC Charleston, S.C.
J - 210 - 504	Sonar Range Prediction	FTC Norfolk, Va.
K - 130 - 579	AN/SQS-35 Indepen- dent Variable Depth Sonar Operator	FLEASWSCOL San Diego, Calif.

K - 130 - 583	AN/SQS-26BX Sonar Operator	FLEASWSCOL San Diego, Calif.
K - 130 - 584	AN/SQS-26CX Sonar Operator	FLEASWSCOL San Diego, Calif.
K - 130 - 596	Submarine Sonar Subjective Analysis	FLEASWSCOL San Diego, Calif.
K - 130 - 1004	Sonar Target Class-ification (BASIC)	FLEASWSCOL San Diego, Calif.
K - 130 - 1024	Sonar Target Class-ification (ADVANCED)	FLEASWSCOL San Diego, Calif.
K - 130 - 1031	AN/SQS-26BX/CX Operator Refresher Training	FLEASWSCOL San Diego, Calif.
A - 431 - 0024	Basic Underwater Demolition/Seal (BUDS) Training	NAVPHIBSCOL Coronado, Calif.
H - 010 - 3923	Amphibious Reconnaissance	LFTC Coronado, Calif.
H - 010 - 3925	Amphibious Reconnaissance	LFTC Coronado, Calif.
H - 010 - 3926	Amphibious Reconnaissance	LFTC Coronado, Calif.
H - 010 - 3927	Amphibious Reconnaissance	LFTC Coronado, Calif.

LIST OF REFERENCES

1. Stephan, E. C., "Oceanography and Naval Warfare," Naval War College Review, v. 14 (7), p. 20-38, April 1962.

2. Shear, H. E., "Oceanography - Its Implication on ASW," Under Sea Technology, v. 12 (11), p. 16-19, November 1971.

3. Oceanographer of the Navy, A Special Report on Oceanographic Program Planning for the Deputy Chief of Naval Operations for Development, 1 July 1964. (CONFIDENTIAL)

4. Secretary of the Navy, Department of the Navy Ten Years Program in Oceanography (TENOC 63-72), April 1964. (CONFIDENTIAL)

5. Mackie, R. R., "The ASW Officer 'Jack of all Trades, Master of None'," United States Naval Institute Proceedings, v. 98 (2), p. 34-40, February 1972.

6. Hoernemann, M. J., "Applied Military Oceanography," The Proceedings of the 8th U.S. Navy Symposium of Military Oceanography, v. 2, 16-18 May 1971. (CONFIDENTIAL)

7. Naval Personnel Research Activity Research Memorandum SRM 70-3, Personnel Implications of New Technological Developments: Undersea Technologies, by D. A. Wilson, p. 27, July 1969.

8. Manual of Qualifications for Advancement, NAVPERS 18068C, 5 May 1971.

9. Leipper, D. F., "Oceanography - A Definition for Academic Use," Transactions, American Geophysical Union, v. 42 (4), p. 429, December 1961.

10. Waterman, L. W., Officer Education and Training in Oceanography for ASW and Other Naval Applications, Ms. Thesis, Naval Postgraduate School, Monterey, California, 1972.

11. Smith, R. H., "ASW - The Crucial Challenge," United States Naval Institute Proceedings, v. 98 (831), p. 128-141, May 1972.

12. Lee, O. S. and Batzler, W. F., "Internal Waves and Sound Pressure Level Changes," The Proceedings of the 1st U.S. Navy Symposium on Military Oceanography, 17-19 June 1964.

13. Bussert, J. C., "Soviet ASW," United States Naval Institute Proceedings, v. 98 (834), p. 112-116, August 1972.

14. Revelle, R., and others, Ocean Sciences, p. 40, United States Naval Institute, 1964.

15. Chief of Naval Operations Letter OP-716/ZN Serial 16P71 to Distribution List, Subject: Long Range Oceanographic Program, 13 March 1961.

16. Naval Training Device Center Technical Report 1494-1, Oceanographic and Hydrographic Systems for Training, by G. V. Padgett and R. J. Dolph, p. 7, May 1966.

17. Panel on Oceanography of The President's Science Advisory Committee Report, Effective Use of the Sea, June 1966.

18. Office of the Oceanographer of the Navy, The Ocean Engineering Program of the U.S. Navy, September 1967.

19. Hearon, O. H., editor, "The Second Million," TRA Navy, p. 10-12, January 1972.

20. Naval Weather Service Command Letter 3161 Serial 1537 to Distribution List, Subject: Operational Oceanographic Support Services Conference; report of, 17 July 1972.

21. Hearon, O. H., editor, "The Director of Naval Education and Training," TRA Navy, p. 2-4, July 1972.

22. Bureau of Naval Personnel Educational Services Manual, NAVPERS 15229, 1967.

23. Naval Personnel Research and Development Laboratory Report WSR 71-3, Report of Enlisted Findings Navy Personnel Survey NPS 69-1, by C. Braunstein, August 1970.

24. Bureau of Naval Personnel Manual, NAVPERS 15791B, 1 July 1969, Article 6630200.

25. Naval Personnel Program Support Activity, Personnel Research Laboratory WSR 69-1, Motivational Effects of the Associate Degree Completion Program Report 3, by T. W. Muldrow, p. 6-7, September 1968.

26. University Curricula in the Marine Sciences and Related Fields, Academic Years 1971-72 and 1972-73, Pamphlet #43, The Oceanographer of the Navy, August 1971

27. Bureau of Ships Report No. 4090266, Internal Waves: Their Influence Upon Naval Operations, Arthur D. Little, Inc., p. 23, 23 February 1966.

28. Antisubmarine Warfare Force, U.S. Atlantic Fleet Technical Report P43-03.16.3, A Longitudinal Study of Airborne, Antisubmarine Warfare Operator (AW) Performance in Various Training Pipelines, by J. H. Johnson, July 1971

29. Dubach, H. W. and Taber, R. W., Questions About the Oceans, U.S. Naval Oceanographic Office, 1969.

30. Taber, R. W., LaPorte, L. R., and Smith, E. C., An Oceanographic Curriculum for High Schools Outline, U.S. Naval Oceanographic Office, 1968.

31. Office of the Oceanographer of the Navy, The Ocean Science Program of the U.S. Navy, April 1970.

32. Naval Underwater Systems Center Publication 4185, Operating Doctrine for the AN/SQS-26 Sonar System: The Command Level Manual(u), by R. C. Chapman and J. G. Keil, p. 10-11, 9 March 1972. (CONFIDENTIAL

33. Naval Underwater Systems Center Publication NL-4053, Operating Doctrine for the AN/SQS-26 Sonar System: The Watch Supervisor's Manual(u), by R. C. Chapman and J. G. Keil, 25 February 1971. (CONFIDENTIAL)

34. Naval Personnel and Training Research Laboratory Research Report SRR 70-21, Research Report on Revising the AW Rating Path of Advancement to Warrant Officer and Limited Duty Officer, by J. R. Heinzel, p. 3, February 1970.

35. Naval Weather Service Command Instruction 3160.2, Subject: Ship, Helicopter Acoustic Range Prediction Systems (SHARPS) II, 3 November 1971.

36. Bell, T. G., "Optimizing AN/SQS-26 Performance by the Use of Environmental Data(u)," The Proceedings of the 8th U.S. Navy Symposium of Military Oceanography, v. 2, 16-18 May 1971, p. 332-334. (CONFIDENTIAL)

37. Manual of Navy Enlisted Classifications, NAVPERS 15105-V, January 1972.

38. List of Training Manuals and Correspondence Courses, NAVPERS 10061-AE, March 1971.

39. Bureau of Naval Personnel Formal Schools Catalog, NAVPERS 91769-A1, February 1972

40. Naval Formal Schools Catalog, Naval Training Command, CNT P1550/1 (9-71).

41. Commander Training Command, U.S. Atlantic Fllet Instruction 1540.1U, Subject: Catalog of TRALANT Courses Available at Atlantic Fleet Shore-Based Training Activities, 1 July 1971.

42. Commander Training Command, U.S. Pacific Fleet Instruction 1500.2V, Subject: Training Digest; promulgation of, 1 January 1971.

43. Commander Amphibious Operations Support Command U.S. Pacific Fleet Instruction 1540.2C, Subject: COMPHIBOPSUPPAC Formal School Catalog, 15 March 1971.

44. Ruhe, W. J., "Seapower in the Seventies," United States Naval Institute Proceedings, v. 96 (806), p. 29, April 1970.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Documentation Center Cameron Station Alexandria, Virginia 22314	2
2.	Library, Code 0212 Naval Postgraduate School Monterey, California 93940	2
3.	Professor D. F. Leipper, Code 58 Department of Oceanography Naval Postgraduate School Monterey, California 93940	20 (for each faculty)
4.	CDR Karl L. Schriner, USNR Headquarters, Fifth Naval District Norfolk, Virginia 23511	1
5.	CAPT E. M. Cummings, Jr. Office of the Oceanographer 732 N. Washington Street Alexandria, Virginia 22314	1
6.	CF Leopoldo Salas R. Direccion De Hidrografia Apartado 6745 Caracas, Venezuela	1
7.	LCDR R. Harder Officer Training Division Fleet Antisubmarine Warfare School San Diego, California 92147	1
8.	LCDR L. W. Waterman 2922 Lincoln Avenue Alameda, California 94501	1
9.	LCDR J. C. Singler Atlantic Fleet ASW Tactical School Norfolk, Virginia 23511	1
10.	LT B. F. Howell U.S. Naval Destroyer School Newport, Rhode Island 02840	1
11.	LCDR C. K. Roberts, Code 58Rb Naval Postgraduate School Monterey, California 93940	1

12. LCDR R. F. Heffernan 1
U.S. Naval Facility
FPO San Francisco, California 96630

13. LT G. S. Bodenhorn 1
Operations Code 3810B
Naval Oceanographic Office
Washington, D. C. 20390

14. Oceanographer of the Navy 1
The Madison Building
732 N. Washington Street
Alexandria, Virginia 22314

15. LCDR R. J. Cepek 1
NAVSECREP Massawa
MAAG Ethiopia
APO New York 09843

16. Department of Oceanography, Code 58 3
Naval Postgraduate School
Monterey, California 93940

17. LCDR M. H. Sollberger 1
USS Lafayette (SSBN 616) (Gold)
FPO New York 09501

18. Commanding Officer 1
Fleet Anti-Submarine Warfare School
San Diego, California 92147

19. Commanding Officer 1
Fleet Sonar School
Naval Base
Key West, Florida 33040

20. Chief of Naval Technical Training 1
Naval Air Station, Memphis
Millington, Tennessee 38054

21. Chief of Naval Training 1
Naval Air Station
Pensacola, Florida 32508

22. Fleet Aviation Specialized 1
Operational Training Group
Pacific Fleet
Naval Air Station
North Island
San Diego, California 92135

23. Fleet Aviation Specialized 1
Operational Training Group
Atlantic Fleet
Naval Air Station
Norfolk, Virgina 23511

24. Commander Training Command 1
U.S. Pacific Fleet
San Diego, California 92147

25. Commander Training Command 1
U.S. Atlantic Fleet
Norfolk, Virginia 23511

26. Commander Antisubmarine Warfare Force 1
U.S. Pacific Fleet
FPO San Francisco, California 96610

27. Commander Antisubmarine Warfare Force 1
U.S. Atlantic Fleet
Norfolk, Virginia 23511

28. Office of Naval Research 1
Code 480
Arlington, Virginia 22217

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

ORIGINATING ACTIVITY (Corporate author) Naval Postgraduate School Monterey, California 93940	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

REPORT TITLE

A STUDY OF ENLISTED TRAINING AND EDUCATION IN APPLIED OCEANOGRAPHY

DESCRIPTIVE NOTES (Type of report and, inclusive dates)
Master's Thesis; September 1972

AUTHOR(S) (First name, middle initial, last name)

Karl L. Schriner; Commander, United States Naval Reserve

REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
September 1972	227	44

a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO.	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Naval Postgraduate School Monterey, California 93940

ABSTRACT

This study concludes that the primary reason for present programs of enlisted training and education in oceanography is to support ASW. There is a significant lack of courses, schools, and self-study material available to enlisted personnel on the subject of oceanography. Through more extensive training the aviation ASW community is more advanced than the surface ASW community in the ability to utilize environmental knowledge of the oceans to their advantage in ASW. ASW sonar technicians are inadequately trained in environmental effects on underwater sound propagation. To increase the oceanography knowledge of all enlisted personnel including STs and to provide enlisted ratings to better utilize training in environmental effects, several programs are proposed. These programs include an ASW sensor rating and an oceanographer rating.

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
ENLISTED EDUCATION						
ENLISTED TRAINING						
OCEANOGRAPHY TRAINING						
OCEANOGRAPHY EDUCATION						
ASW TRAINING						
ASW SENSOR OPERATORS						
ASW OCEANOGRAPHY						

21 APR 76 24063

Thesis 136195
S348 Schriner
c.2 A study of enlisted
training and education
in applied oceanography.